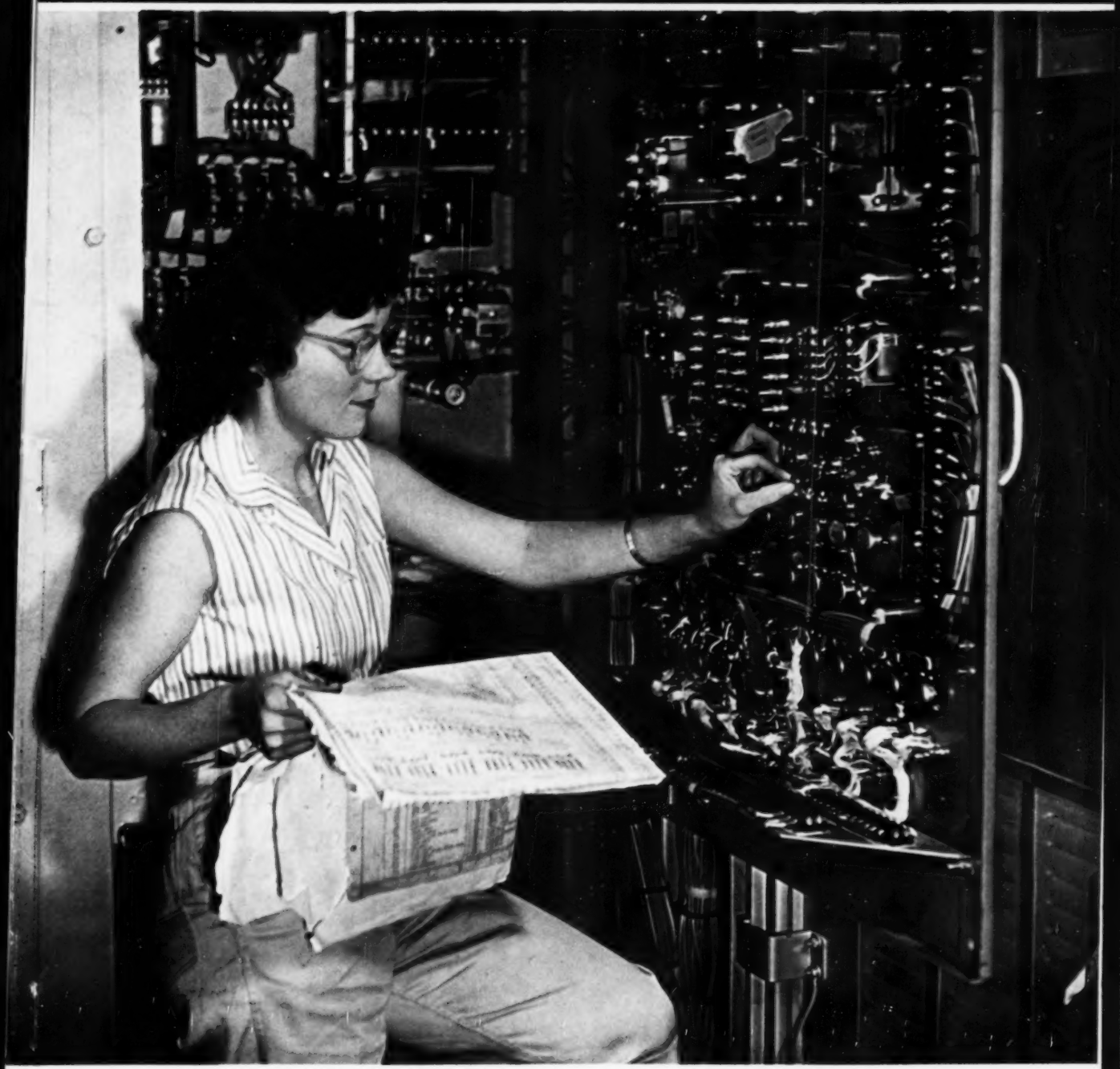
American Machinist

APRIL 20, 1959 75¢

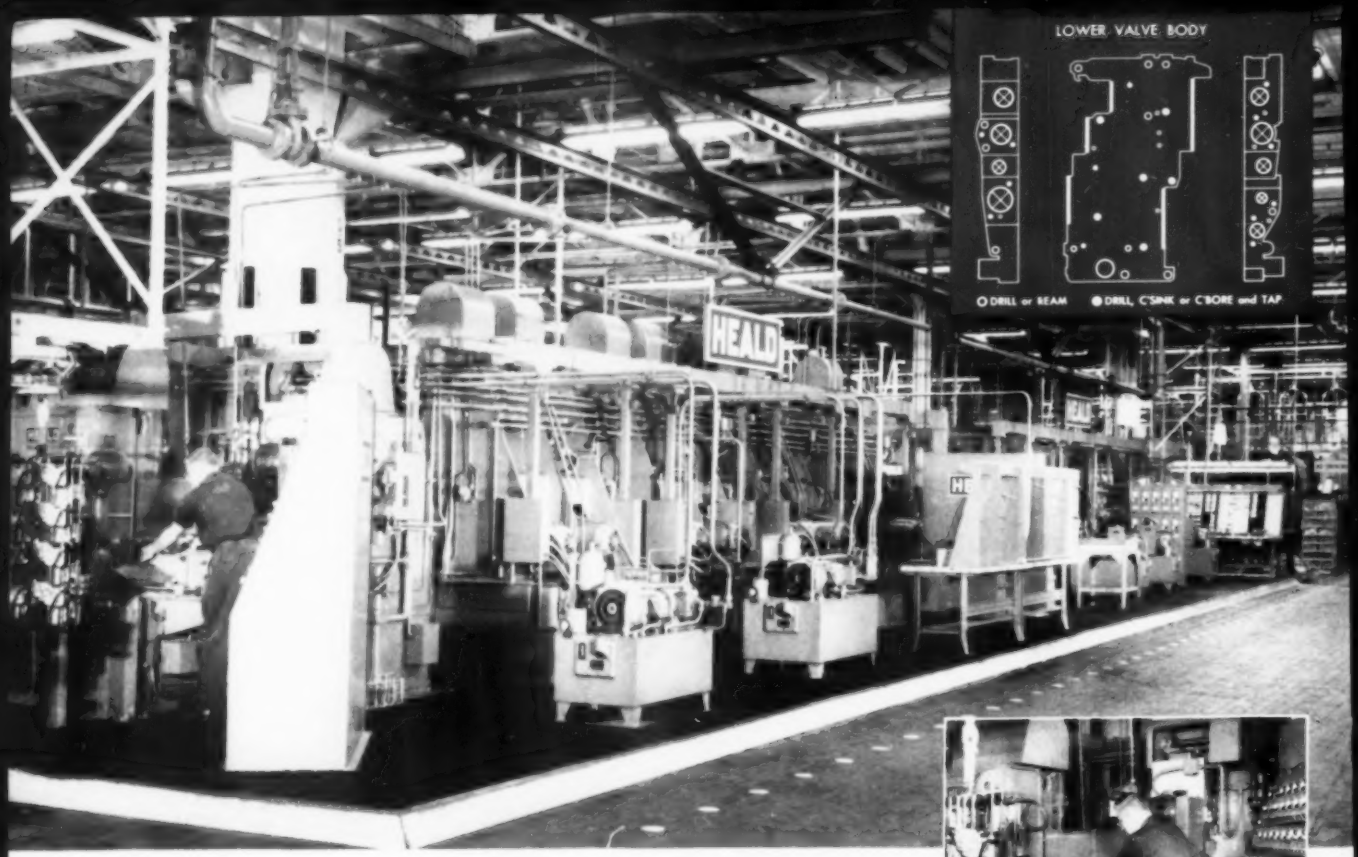
McGRAW-HILL MAGAZINE OF METALWORKING PRODUCTION

DERMATITIS CONTROL

see page 107



Checking connections on an electronic tracer control unit—see page 121



HEALD AUTOMATED LINE performs

171 OPERATIONS

Two identical 39-station Bore-Matic transfer lines drill, bore, ream, tap, face, probe and gage 48 bores and 5 side faces of transmission valve bodies

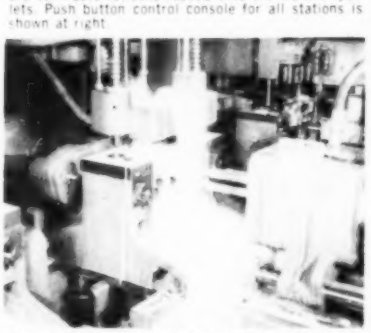
REPRESENTING the ultimate in straight-line automation, these Heald Model S Bore-Matic transfer lines are speeding the precision production of valve bodies at one of America's leading automotive plants.

Each line consists of two 50-foot sections—a 19-station section for the small-bore and semi-finish facing operations and a 20-station section for core drilling, reaming and finish facing. A total of 171 operations (112 machining, 52 probing and 7 air gaging) are performed in a fully automatic palletized transfer line with a cycle time of 13 seconds for each station.

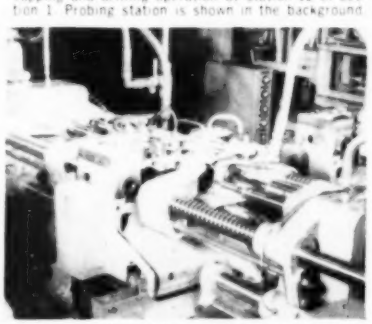
Compared to previous methods, the new Heald system results in less handling and locating of parts, fewer rejects, greater efficiency and substantially lower production costs.

For complete information on this interesting installation, send for a copy of the February 1959 issue of The Heald Herald.

Parts come to machine on overhead conveyor and are semi-automatically loaded onto the transfer pallets. Push button control console for all stations is shown at right.



Tapping and drilling operation at Station 12 of Section 1. Probing station is shown in the background.



Core drilling of spool bores at Station 4 of Section 2. Bores are then semi-finish and finish reamed and air gaged for diameter.

IT PAYS TO COME TO HEALD!

THE HEALD MACHINE COMPANY

Subsidiary of The Cincinnati Milling Machine Co.

Worcester 6, Massachusetts

Chicago · Cleveland · Dayton · Detroit · Indianapolis · New York

American Machinist
McGRAW-HILL MAGAZINE OF METALWORKING PRODUCTION

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TURN PAGE FOR METALWORKING REPORT →

METALWORKING REPORT

SIGNIFICANT CURRENT DEVELOPMENTS IN TOOLING AND PRODUCTION PROCESSES

CUTTING

New Soluble Coolant

A water-soluble coolant that is claimed to stop rusting, resist rancidity, and reduce dermatitis has been introduced by Johnsons Wax. Called Cold Stream, the product is said to stay clean for weeks even when used on cast iron. The new material includes anodic and passivating rust inhibitors, but does not include a bactericide. The Johnson people claim it will cool more effectively than water, based on tests at Twin Disc Clutch. AMERICAN MACHINIST editors have learned that the material is made up principally of synthetics and probably does not contain any wax.

Hula-Head Cutting

Contour shapes can be cut in honeycomb cores without filling the cores with ice or other rigidizers on a machine developed by The Martin Co. The portable head developed by Carlton Jenkins converts a standard 3-axis milling machine to a 5-axis machine by introducing tilt up to 10° in two directions. The stylus has five pick-up points to ride the contours of the model, duplicated by the knife edge cutter.

Electrode Shape the Key

In electrical-discharge machining, there is growing evidence that the choice of electrode shape is the key to success. In a study of five electrode shapes at Purdue University, the 90° point was found to be superior because of its particle-evacuation abilities. See page 133.

FORMING

Plate Sheared Without Bowing

Flat-steel sprockets should be blanked from flat stock, for both die and product reasons. But these sprockets are blanked from strips sheared from plate.

If the rake of the shear blade is not set just right, you are likely to get some bowing in the cut-off strips. Diamond Chain Co, Indianapolis, avoids this condition by using a Pacific hydraulic shear with adjustable rake. One man handles the shear, feeding stock from 4 to 10 ft long. Cut strips drop out the back of the shear to a special chute, and thence into trucks for transfer to the presses.

Extruded Alloy-Steel "Can"

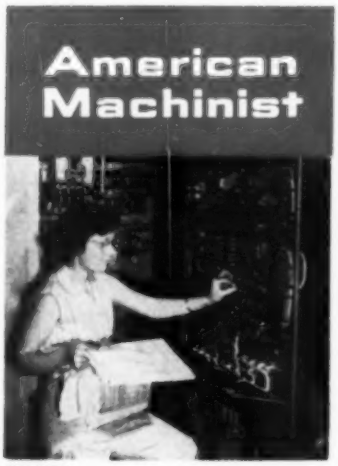
SAE 4130 chrome-moly steel is being impact extruded at Matthews Manufacturing Co, Hawthorne, Calif. Product is a "can"-like part 6-in. high, which is produced in three press operations. For the first operation, slugs 1 5/16 in. long are cut from 3 5/16 in. bars, pack annealed, and backward extruded with a pressure of about 300,000 psi. Stress relieving after the first and the second operations is done by heating to 1250 F and cooling in air. Yield strength in the final can is 120,000 psi.

Lubrication and tool design are responsible for successful impact extrusion of alloy steel. After each forming operation, the part is pickled, rinsed, coated with zinc phosphate, neutralized and lubricated with a soapy substance.

For the punches and dies, Matthews treated Lehigh H (Type D2 tool steel—1.55 carbon, 11.50 chromium, 0.40 vanadium and 0.80 molybdenum) as follows: (1) after machining heat to 1850 F and air quench, then double draw, and (2) after grinding, draw at 950 F. By this treatment, the shop obtains a compressive yield strength of about 600,000 psi or 20% above normal, and the hardness is C-62. Anticipated production from a die assembly is up to 200,000 pc, as compared to only 5,000 pc by hot working.

CAUTION

These pages are not a synopsis of this issue of American Machinist. Major articles are described briefly in the Contents page. Because the Trends pages are classified by subject, they are not described anywhere else. Most of the developments in this department are so new that further information is not yet available —when it is, you will find a page reference to the article.



COVER:
Check of connections on a tracer control unit is made at Specialty Control Dept of General Electric. The unit is one of three going to France for use in Mystere jet fighters. Machines were purchased on a NATO contract. For a review of control systems for machine tools, see page 121.

HEAT TREATING

"Plastic" Quench for Steels

Some medium-carbon steels crack when quenched in water, yet will not harden uniformly when quenched in oil. An intermediate quench is needed. One answer would seem to be a recently developed quenching media consisting of polyvinyl alcohol mixed 5 to 30 parts by weight with 10,000 parts water. This so called plastic quench reduces the quenching rate enough to eliminate cracking in most cases, and often increases the fatigue life of the part.

As the austenitic part enters the solution, the familiar vapor envelope forms. A viscous gel also appears around this envelope, keeping the part hot for a longer time than when quenched in water. When cooling is complete, a thin vinyl coating remains on the part and retards rusting.

The solution can be used in pressure spray quench systems and in immersion quench tanks. It is nonflammable and non-toxic, and can be adjusted within the range from 0.05 to 0.30% polyvinyl alcohol to give a quench approaching that of water or oil.

International Harvester, Chicago,

reports that the use of this plastic quench, in place of the usual water quench, in an induction hardening operation on 32-in.-dia, C 1045 steel gears resulted in tripled fatigue life. The effect was about equal to that achieved by shot peening; plastic quenching and shot peening combined extend fatigue life even further. Northern Ordnance, Inc, Minneapolis, has used the technique successfully on induction-heated C 1050 steel shafting, and in progressive quenching of alloy-steel pinion teeth.

INSPECTION

3-D Viewers Aid Inspectors

It's a problem to get and keep standard samples, as used by visual inspectors. First, you have to get together standard samples that show all possible defects. Second, if the standards rust or are lost, you must start over, and work up a new set.

The standard-samples problem has been licked by the Timken Roller Bearing Co. This firm has five bearing-manufacturing plants, thereby compounding the problem.

Timken selected cups, cones, cages and rollers for maximum passable defects, then photographed them in 3-D. Positive transparencies were stripped into a continuous roll for the viewers. All plants received viewers, which are now in use by inspectors for training purposes and quick reference.

WELDING

Joining With Explosives

Growing out of explosive forming is a joining technique that actually strengthens the material at the joint by cold working it. Fusion welding melts it and leaves a brittle, cast structure that must be heat treated for full physical properties.

Advanced experiments at National Northern Division of American Potash and Chemical Corp have welded similar metals and some important dissimilar combinations: aluminum to stainless, stainless to mild steel, titanium to aluminum, and molybdenum to various metals. Tests indicate these are true metallurgical bonds. A stainless-to-mild-steel sample stayed together even after 24 hr at 1200 F.

The parts to be welded are simply degreased and placed on a backup plate. No flux or other cleaners are employed. Then a calculated, shaped charge of high explosive is detonated. Pressures up to 3 million psi force the parts into intimate contact, and the weld is completed.

Vibration-assisted Welds

Ultrasonic energy, in addition to its ability to make welds by vibration alone, shows promise of being an aid to the fusion-welding processes. In arc welding, it can reduce the surface tension of the molten metal to provide better wetting action, and at the same time, it can shake the entrapped gas bubbles out of the weld zone and reduce, or eliminate, porosity in the weld. Then, as the metal cools and solidifies, the vibrations would prevent the formation of a large grain structure.

So say John N Antonevich and Robert E Monroe, research scientists at Battelle Memorial Institute, Columbus, Ohio. But, they also point out the problems that must be overcome by research before these advantages can be realized.

The ultrasonic vibrations increase the rate of cooling, so there is a shorter time for the favorable effects to act. Reaction rates are also increased and may accelerate hydrogen embrittlement and undesirable alloying. When these problems are solved, however, better joints may be possible, not only in arc welding, but also in resistance welding and brazing.

ASSEMBLY

Chem-milling Assembly Flanges

Extra strength at assembly points can be insured when flanges are built up to extra thickness. Martin Co does this for Titan aluminum-alloy spherical tanks by chemically milling the tank sections, leaving heavy flange areas where the sections join together. The flanges are welded together, and should be later heat-treated to relieve stresses and prevent excessive grain growth. But these tanks are too large and unwieldy to allow heat-treating; which leaves the welded areas with less unit strength than unwelded areas. Total strength at each welded joint is boosted, in spite of lower unit strength, by making the flanges heavy.

Tape-control Savings

How much does tape control save in time and floor space? One quote is from Bert Lindgren, tool design engineer at Grumman Aircraft, where a General Drivmatic riveting machine for aircraft panels has been mechanized for tape control. The savings estimates are 26.6% in assembly time and 20-50% in floorspace. The machine drills, countersinks, inserts, and bucks the rivets at high speed. "Tape" in this case means nylon film —35 mm wide—which outlasts acetate film. Incidentally, operators have to be above average intelligence to handle the equipment, but there is so little to do that they get bored. Grumman reduces this effect somewhat by rotating operators around several machines, each of which is slightly different.

Water Evaporates Soldering Heat

Heat sinks that remove soldering heat from light, easily damaged electronic assemblies are made by attaching metal clamps with water-soaked felt pads. Application is at Boeing Aircraft, where heat-sensitive components are assembled to circuit boards with the clamps, then connecting wires are soldered. Heat of evaporation is drained from the clamped assemblies.

FINISHING

Questions About Nickel Plating?

Nickel plating is a well-developed, useful process that perennially stimulates interest among engineers and shop men. So they ask all sorts of questions. Naturally, the International Nickel Co. gets a flood of telephone calls and correspondence on various aspects of nickel plating, coating and electro-forming.

In a situation like this, someone eventually gets the bright idea that the questions and answers should be collected and assembled in a coherent whole. See page 147.

Water-base Paints

The dangers and difficulties inherent in conventional baking finishes, with their low-flash-point solvents, can now be avoided by the

THE OUTLOOK

Slowly rising demand for capital goods already is giving a firmness to metalworking production that is the basis for further expansion of operations as the year goes on. Orders for steel reflect improvement in business even more than strike fears. *For details see page 101.*

use of acrylic polymers in a water base, such as the Rhoplex finishes now being introduced by Rohm & Haas. With more and more use of dip painting, the danger of fire and explosion is increasing, but these hazards are eliminated with the water-base paints. Volatile solvents also create other difficulties—they are expensive, and costly recovery systems may be necessary and, even with these, there is constant danger of air pollution, toxic effect, and dermatitis.

The new finishes bake to a hard, glossy film that shows unusual resistance to humidity and chemical action, excellent adhesion and impact resistance, outstanding color retention, and remarkable durability. They are available as both primers and top coats in a wide range of colors, including a white with a gloss comparable to that of standard melamine alkyd enamel.

Potential for these finishes ranges from automobile bodies to machine tools, domestic appliances, furniture, motors, and even steel drums.

MATERIALS HANDLING

Side-Transfer Handling

A new fork-truck attachment lets the truck load and unload in narrow aisles without making the usual 90° turn. Called STOW (for Side Transfer Optimum Warehousing), the attachment is built by Equipment Manufacturing, Inc, Detroit.

On the attachment, the forks are shifted 90° from the usual position, and move at right angles to the operator during loading or unloading. Special channeled racks support the attachment during operation, so that load weight being shifted doesn't become unbalanced. Maker claims that the attachment, which will fit any standard fork-lift truck, can cut normally needed 12-ft aisles by more than 50 per cent.

MATERIALS & COMPONENTS

Castable High-Temp Alloy

New nickel-chrome castable alloy, developed especially for high-temperature investment-cast parts to be used in advanced jet aircraft and missiles is available from the International Nickel Co. Alloy, designated 713C, combines outstanding strength at 1700F with good castability.

High-Temperature Lubricant

Lubrication problems in specialized industries such as steelmaking, glass, ceramics, diecasting, and similar processes where high temperatures are a factor in production may be solved by a new grease. Just perfected by the Standard Oil Co (Indiana) to lubricate the bearings in the internal brake assemblies on supersonic jet planes, the new grease lubricates at temperatures from –65F to higher than 400F. It is called Supermil ASU 06752; is a synthetic, compounded with aryl-substituted urea as a thickener in a special nonpetroleum lubricating fluid.

Developers expect the material to solve a variety of lubrication problems in heat-treating equipment, drying and baking ovens, die-casting machines, plastic-molding machines, extrusion presses, hot-pressing and rolling equipment, and many other metalworking mechanisms. It should prove especially useful for automatic handling equipment used in conjunction with high-temperature processes.

Epoxy Rebuilds Worn Ways

Where machine-tool ways or tailstocks require a build-up of only a few mils, Frost Rebuilding Co (Los Angeles) uses Helix Bonding Agent R-313 epoxy, or R-320 which contains graphite to provide a lubricant. Material is obtained from Carl H Biggs Co, Santa Monica, Calif.

MANUFACTURING CONTROL

Avoid Inflated Costs

Avoidable costs amplified by the inflationary spiral of wages and prices are an important consideration in evaluating equipment investment, according to a new replacement formula proposed by the Jones & Lamson Machine Co (Springfield, Vt). In two parts, the formula first determines the avoidable costs for the first full year (next year) without the new or proposed equipment. Then, Part 2 of the formula is used to project these costs in terms of wages, materials, and the increased selling price of the equipment over a five- and a ten-year period of deferred purchase. Final determination of the best investment is made by comparing ratios. "Formula" consists of simple two-page form. Details on page 130.

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CINCINNATI

Look!

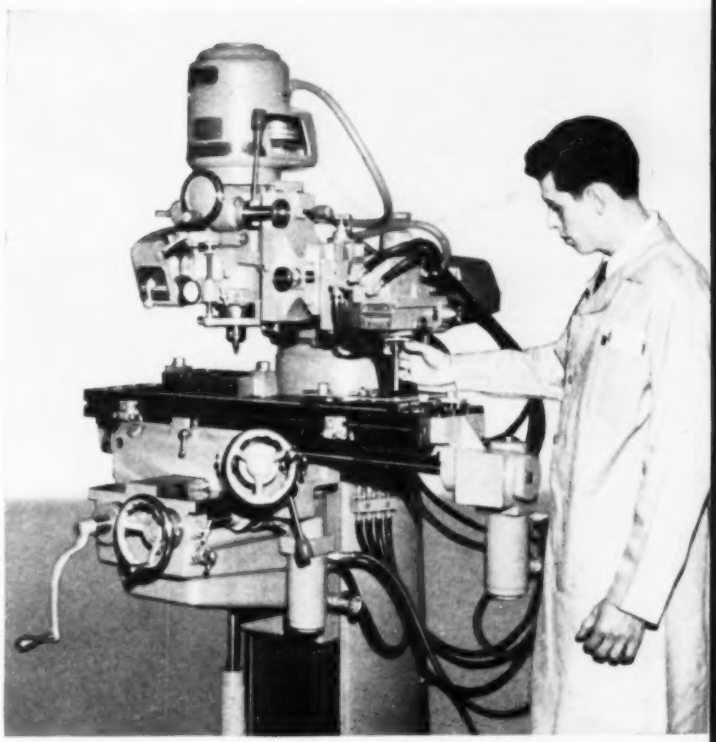
ONE HAND GUIDES 3-DIMENSIONAL MILLING

on CINCINNATI Contourmaster

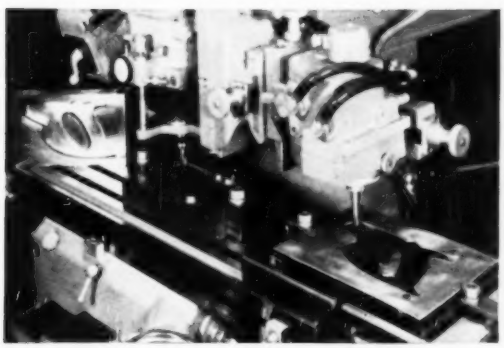
Ask any tool and die maker. Manual control still is highly desirable for roughing out die and mold cavities. There are several ways to perform this type of operation, but the quickest and easiest is on a CINCINNATI No. 1C Contourmaster Milling Machine with its single manual control . . . the 3D hand guided hydraulic tracing unit. This amazingly responsive mechanism directs the table to move right or left; the saddle to traverse in or out; and the cutter spindle to go up or down. All these feed movements are controlled through simple deflection of the tracing finger, as shown in the illustration at right. For conventional toolroom milling, the tracing unit can be quickly disengaged and feed control handwheels employed.

Check into the many advantages of CINCINNATI Contourmasters for your tool and die shop. Complete information on Style 1C will be found in catalog No. M-2008; Styles 1A and 1B, catalog No. M-1919-2.

The Cincinnati Milling Machine Co.
Cincinnati 9, Ohio



THREE-DIMENSIONAL MILLING. Longitudinal, cross and vertical (quill) feed movements are activated through deflection of the tracing finger on the Hand Guided Hydraulic Tracing Unit, a standard feature of CINCINNATI No. 1C Contourmaster Milling Machines. 22″ table traverse; 10″ cross traverse; 42″ x 10″ table working surface. Catalog No. M-2008.



PLASTIC SAW HANDLE MOLD, a typical job for the 3D feature-advantage of CINCINNATI No. 1C Contourmaster. Note the variety of curves in the long outline of the master template (right), and the increase in depth from front to back of the handle.

KNEE TYPE AND BED TYPE MILLING MACHINES • DIE SINKING MACHINES
• CUTTER AND TOOL GRINDERS • ELECTRICAL DISCHARGE MACHINES

CINCINNATI
MILLING MACHINE DIVISION

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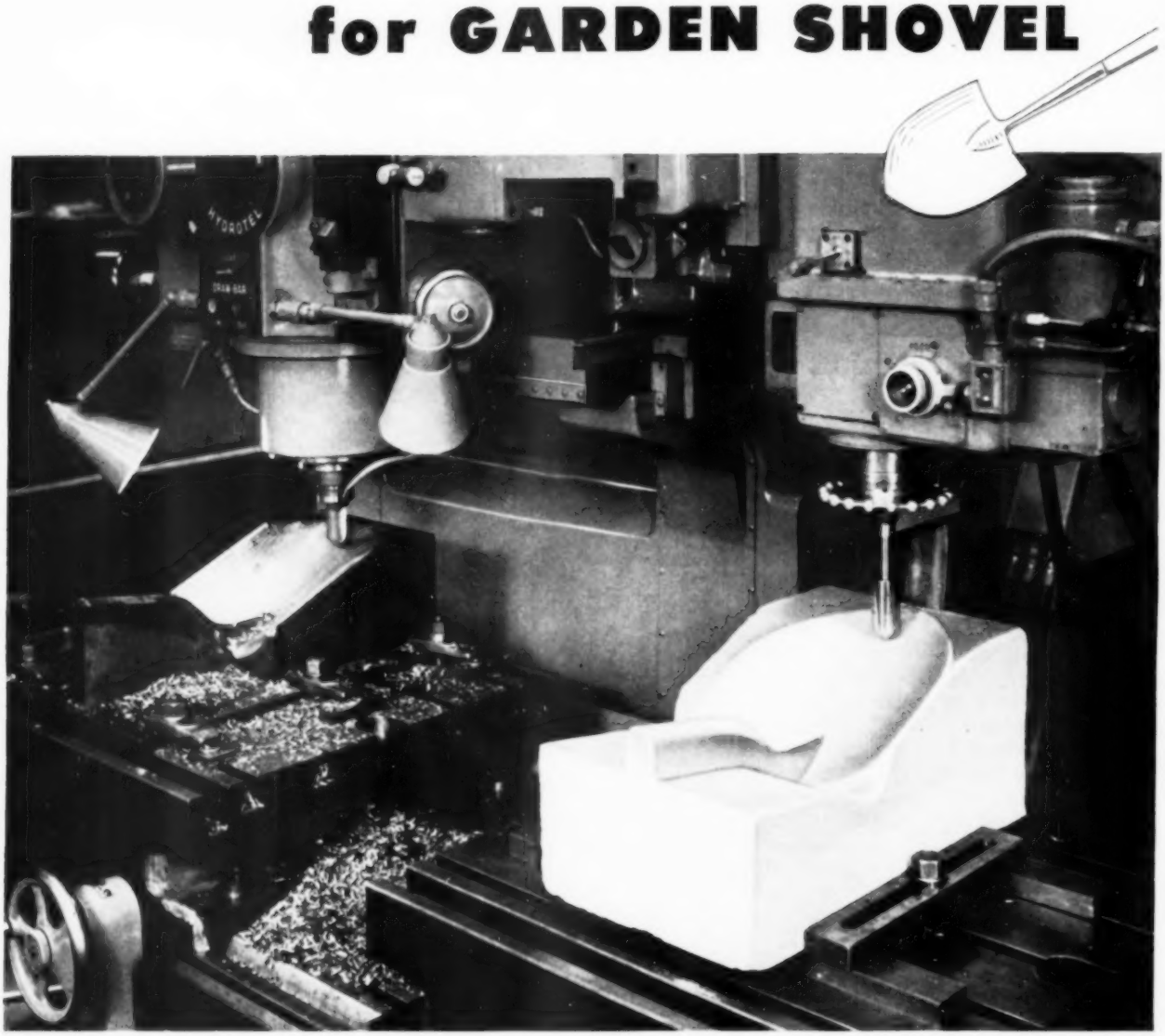
DEEP-CAVITY DIE for GARDEN SHOVEL



CINCINNATI 30" HYDRO-TEL automatically mills deep-cavity shovel mold in one setting. Because of the smooth action of the vertical hydraulic tracing unit, hand-finishing is much less than in similar jobs produced on other machines.

CINCINNATI VERTICAL HYDRO-TEL MILLING MACHINES

CATALOG	SIZE	TABLE WORKING SURFACE	TABLE TRAVEL	CROSS TRAVEL	SPINDLE DRIVE
M-1497-1	16"	16" x 53"	30"	16"	5 hp
M-1773-3	28"	28" x 83" 28" x 119" 28" x 143"	60" 96" 120"	30" 30" 30"	7½ or 10 hp 7½ or 10 hp 7½ or 10 hp
M-1923-1	30"	28" x 83" 28" x 119" 28" x 143"	60" 96" 120"	30" 30" 30"	20 hp 20 hp 20 hp

BUILDERS OF FINE MACHINE TOOLS: KNEE TYPE AND BED TYPE MILLING MACHINES • DIE SINKING MACHINES •

THE CINCINNATI MILLING MACHINE CO., CINCINNATI 9, OHIO

CIRCLE 172 READER SERVICE CARD

GROWS PROFITS

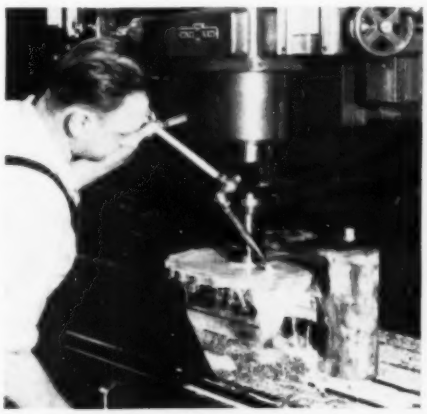
WHEN MILLED ON A CINCINNATI HYDRO-TEL

Making profits grow and flourish is the principal "occupation" of CINCINNATI Hydro-Tel Milling Machines. Consider the lowly garden shovel, for example. The die for forming the business end of the shovel is a classic in deep-cavity proportions, as can readily be seen from the illustration at the left. A plaster cast serves as the master. When cross feed to the ram is engaged, the tracer finger lightly scans the vertical profile of the master and the cutter spindle head follows exactly the same path.

This CINCINNATI Hydro-Tel, a 30" Vertical, takes heavy cuts easily and smoothly, as indicated by the size of chips on the machine table. In addition to its heavy cutting capacity and light-fingered automatic tracing, the 30" Vertical offers many additional feature-advantages. All slides are hydraulically powered. No appreciable effort is required for hand traverse. Table, cross slide and vertical power feeds are independent of each other. Hand feed for any slide can be used in conjunction with power feed for any other. Several types of equipment are available, including automatic depth tracing, automatic 360° profiling, combinations of the two foregoing functions, and multiple spindle heads.

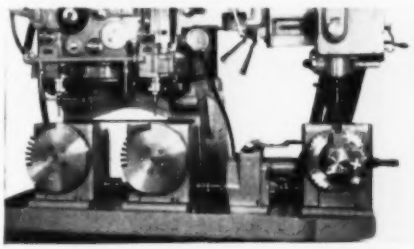
CINCINNATI Hydro-Tel Milling Machines are far in front of others performing the same type of work. May we tell you more? Ask for the catalogs listed in the table.

OTHER **CINCINNATI HYDRO-TEL**
MILLING MACHINE APPLICATIONS



28" VERTICAL HYDRO-TEL performing a conventional milling operation. Without tracing equipment, Hydro-Tels are efficient general-purpose millers.

28" VERTICAL HYDRO-TEL equipped with a four-spindle head and 360° Automatic Profiling Unit for continuous path milling. Contours of four connecting rods are milled simultaneously.



16" VERTICAL HYDRO-TEL equipped with 360° Automatic Profiling Unit for continuous path milling, and tooled up to mill the profile of turbine blades from the solid, two at one time.

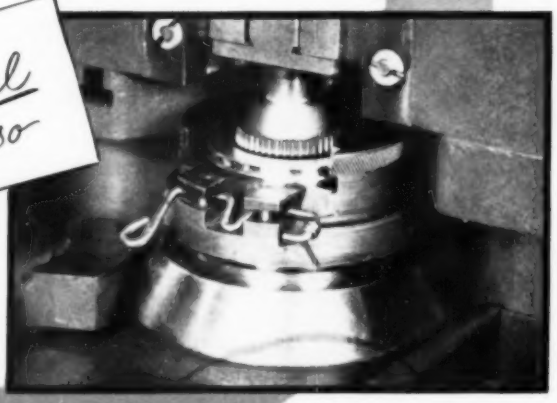
CINCINNATI

CUTTER AND TOOL GRINDERS • ELECTRICAL DISCHARGE MACHINES

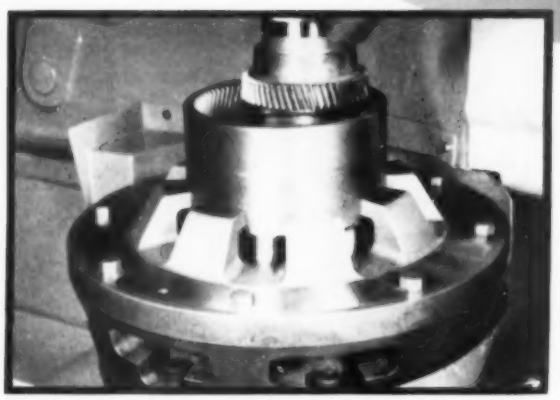
CINCINNATI®
MILLING MACHINE DIVISION

CIRCLE 173 READER SERVICE CARD

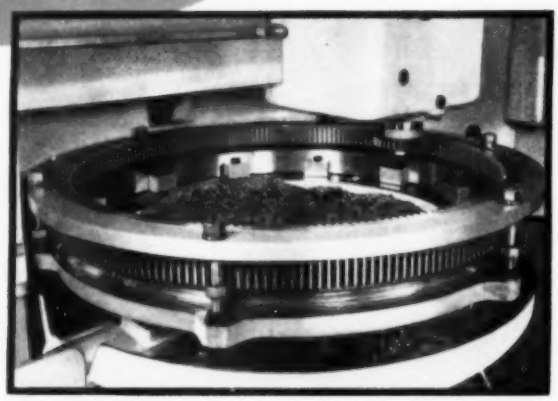
FELLOWS GEAR SHAPERS
cut INTERNAL Gears



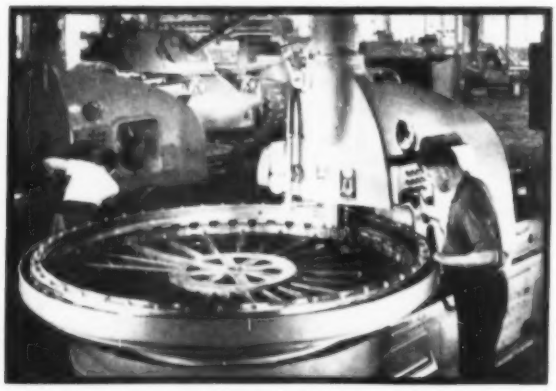
5' Fine-Pitch Gear Shaper cutting internal gear



No. 10 Rotary Gear Shaper cutting internal helical.



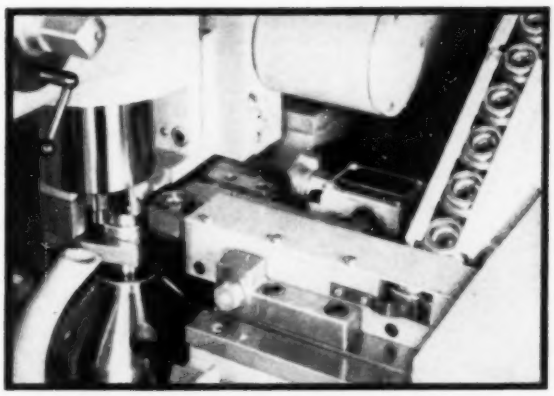
36-Type Gear Shaper with special work-holding fixture.



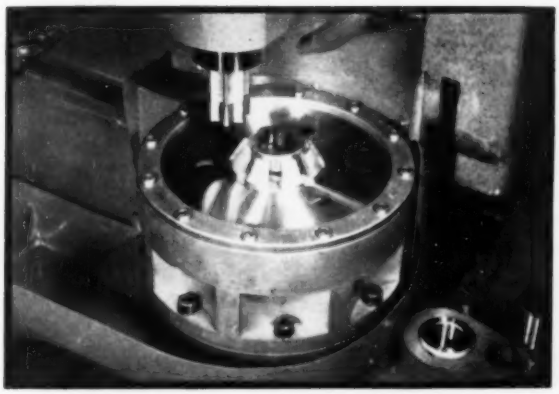
120" Gear Shaper cutting light tank turret gear.

THE
PRECISION
LINE

as EASILY as Externals



4GS Gear Shaper with full-automatic operation.



7A-Type Gear Shaper with fast-action diaphragm chuck.

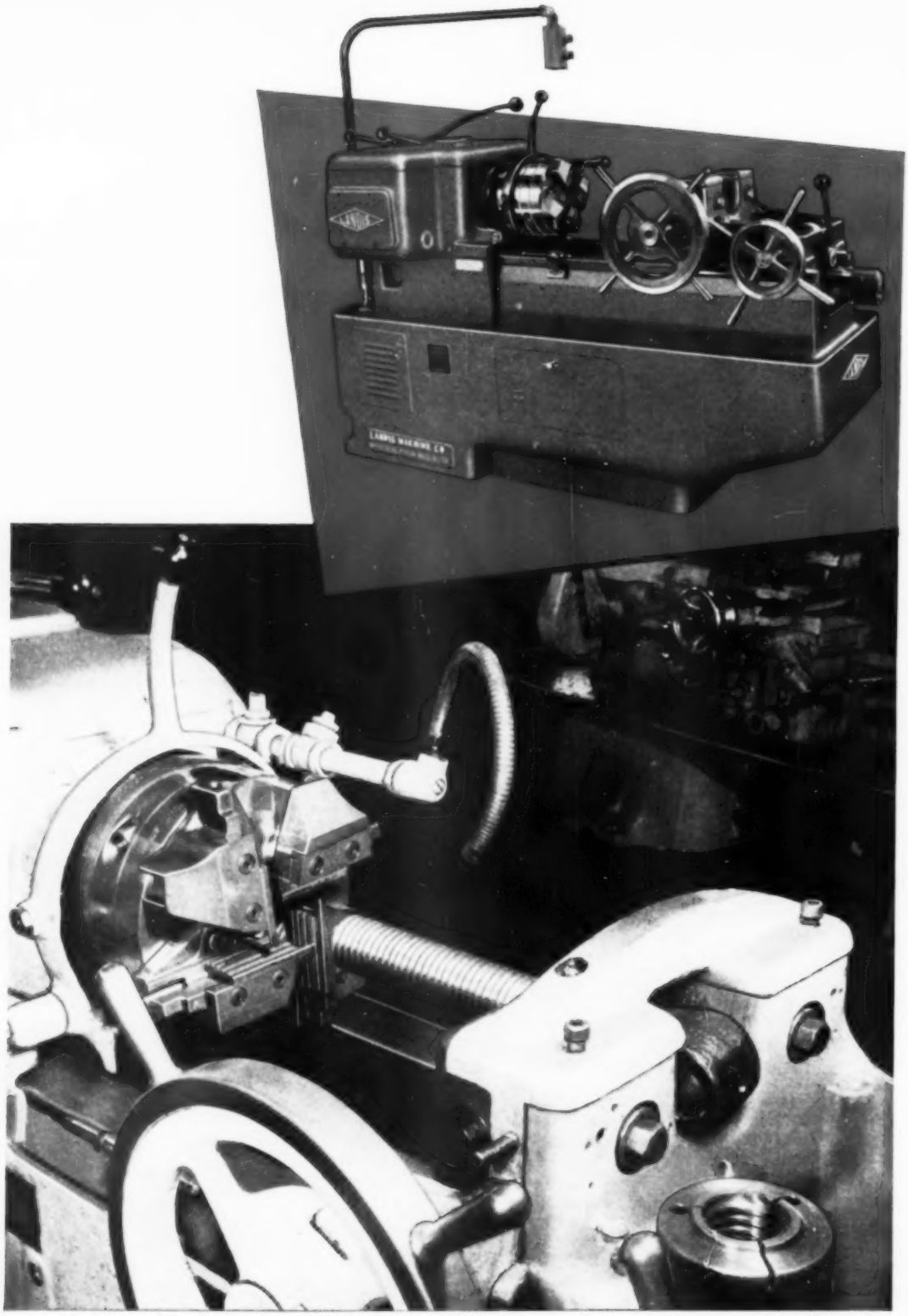
Not only internal gears, but splines, clutches and an almost unlimited variety of other internal shapes can be produced on versatile Fellows Gear Shapers just as simply, rapidly and economically as external shapes. In many cases, the same Gear Shaper cutter can be used to cut both internal gears and their mating pinions.

Set-ups and change-overs are simple and fast on any Gear Shaper from the 3-Inch Fine-Pitch to the 120-Inch. Rigid construction makes it possible to hold close tolerances at high production rates. On some models, full or semi-automatic operation is available whenever the size and shape of the work and the production requirements make it practical.

Your Fellows Representative can give you full information about the production benefits of Fellows gear shapers, shaving machines, grinding machines, inspection instruments, or cutting tools. Just contact the nearest Fellows office.

THE FELLOWS GEAR SHAPER COMPANY
78 River Street, Springfield, Vermont
Branch Offices: 1048 North Woodward Ave., Royal Oak, Mich.
150 West Pleasant Ave., Maywood, N. J.
5835 West North Avenue, Chicago 39
6214 West Manchester Ave., Los Angeles 45

Fellows *Gear Production Equipment*



461-C -2

coarse threads

cut in one pass with LANDMACO machines

The cutting of large diameter Acme threads at the Iowa Manufacturing Co. of Cedar Rapids, Iowa, illustrates the heavy duty threading possible on LANDMACO Threading Machines.

1045 steel forgings of 20-29 Rockwell C are used in the production of adjusting screws for construction equipment. 2¼"-3 pitch Special Acme threads (EXTRA DEEP) are cut 10" long, with a .026 pitch diameter tolerance and a .001 per inch allowable lead error.

Cutting at a speed of 7.6 surface feet per minute, 12.5 pieces are completed per hour. This includes 100% gaging on the machine, using go-and-no-go gages. Despite the large amount of metal removal, at least 80 pieces are produced between chaser grinds.

This job is an excellent example how such heavy-duty threading can be done with the LANDMACO Machine. The 2½" Single Spindle Machine (½" to 2½" range) used here features heavy construction, hardened-and-ground ways, lead screw attachment, and is equipped with a rugged LANCO Tangential Chaser Die Head. Roughing-and-Finishing Centering Throat Chasers produce heavy cuts in one pass of excellent finish, eliminate the out-of-roundness common in long heavy workpieces, and provide low tool cost.

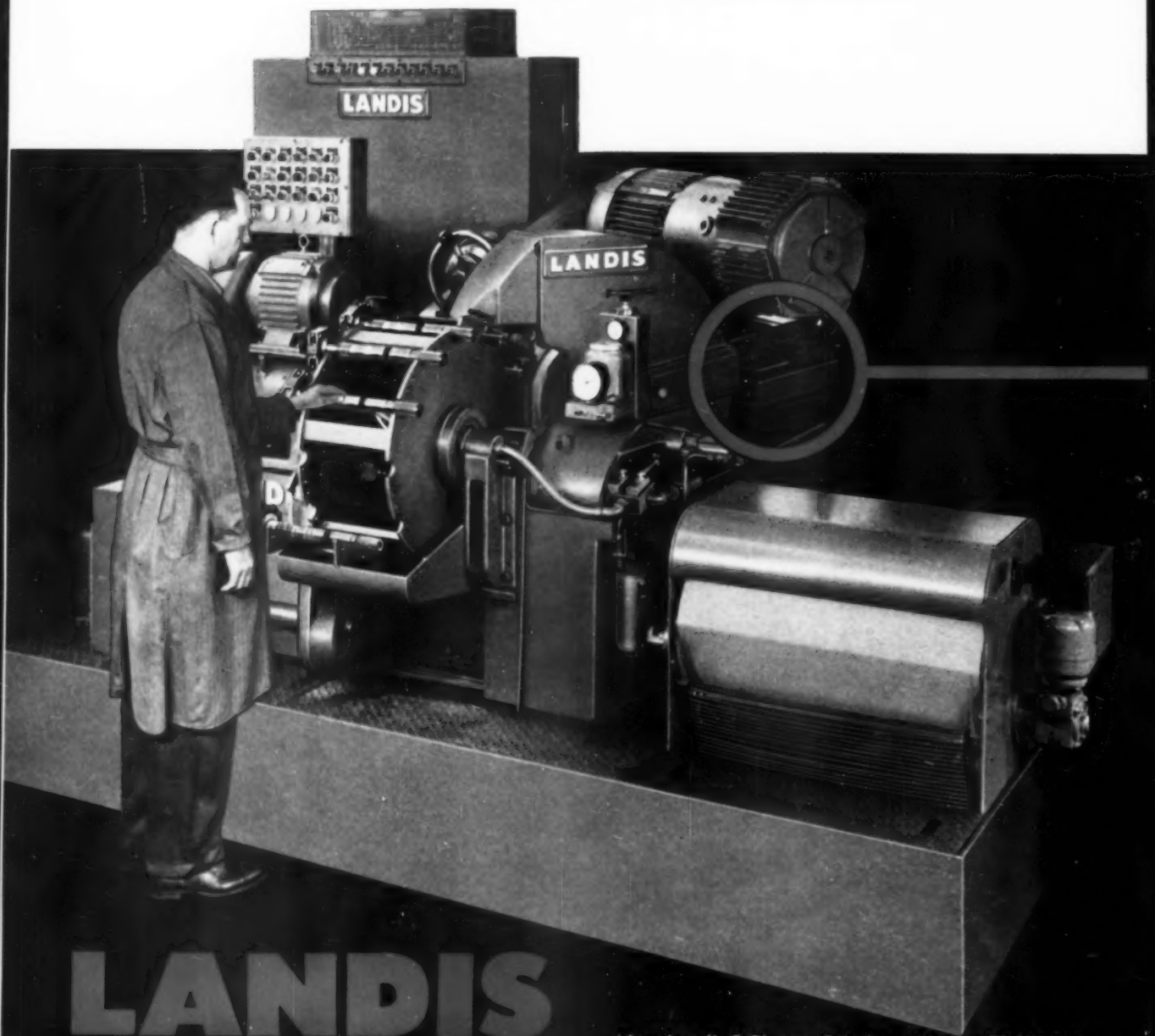
LANDMACO Machines offer precision and heavy duty threading within a range of ±4 to 4" in diameter. For more detailed information, please send specifications when writing.

THE WORLD'S LARGEST MANUFACTURER OF THREADING EQUIPMENT - CUTTING - TAPPING - GRINDING - ROLLING

LANDIS Machine COMPANY

WAYNESBORO PENNSYLVANIA

new Landis truform dresser maintains closer



LANDIS

precision grinders

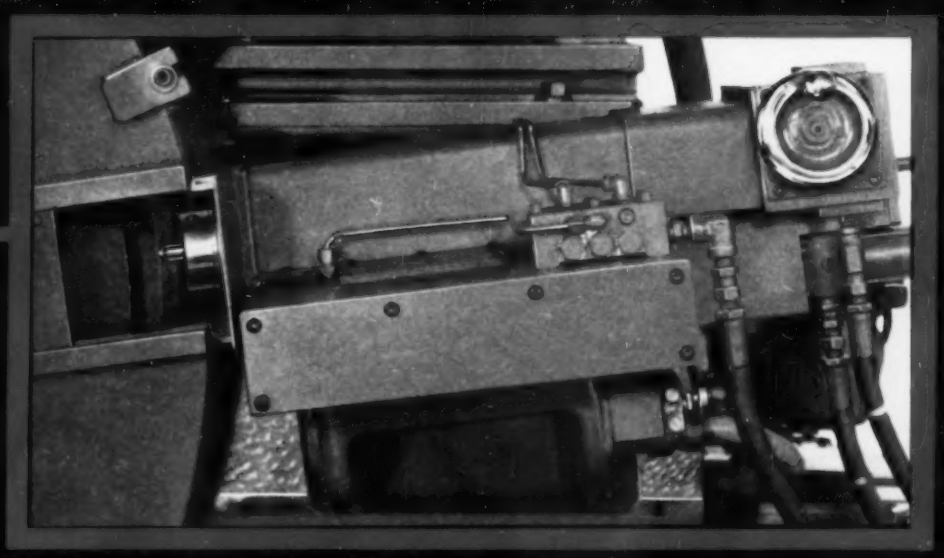
New Landis R Plunge Grinder with new TRUFORM dresser, automatically grinding 3 diameters and face of transmission shaft in one operation.

LANDIS TOOL COMPANY / WAYNESBORO, PENNSYLVANIA

improves accuracy, tolerances

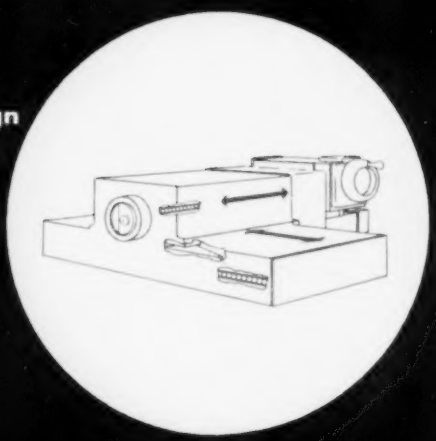
TRUFORM DRESSER is an exclusive Landis development with these special advantages:

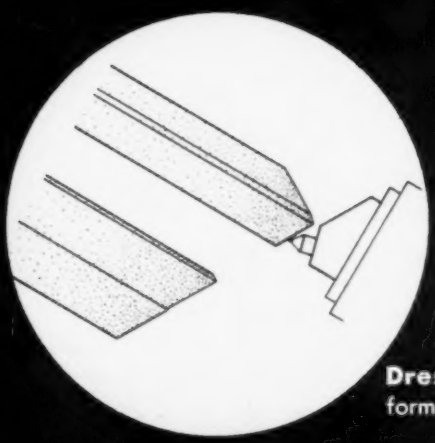
- preloaded ball slide with no shake gives more accurate dressing
- dresses in either direction up to 60° angles
- pushbutton control assures uniform dressing cycles
- built-in accuracy cuts dressing time—saves on diamond costs
- automatic lubrication for continuing accuracy



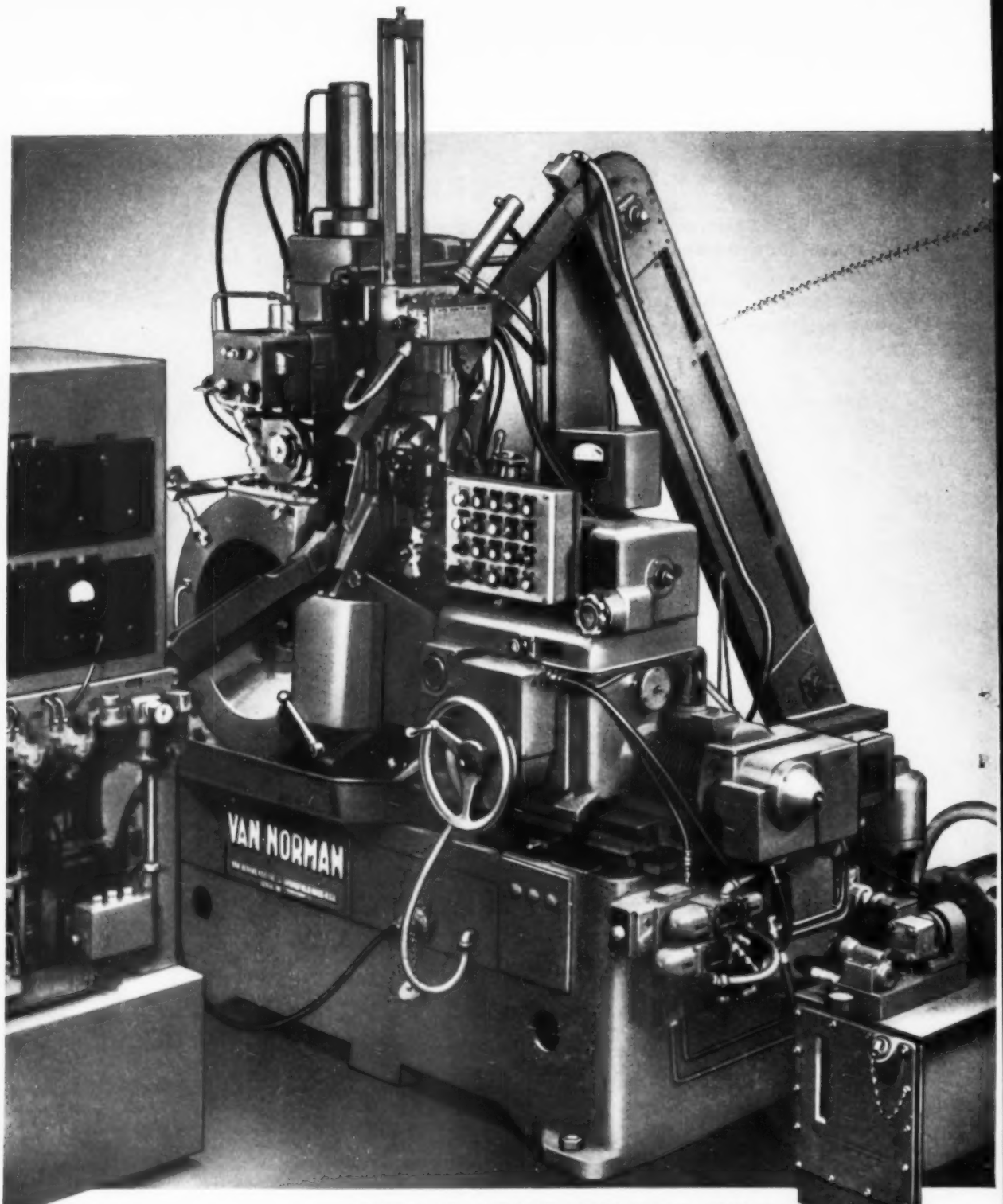
Exceptional accuracy and stability always assure exact duplication of the profile to the wheel.

New pre-loaded ball-slide design eliminates shake for accurate dressing.





Dresses a Profile of 60°—new dressing efficiency forms wheel profiles not possible before.



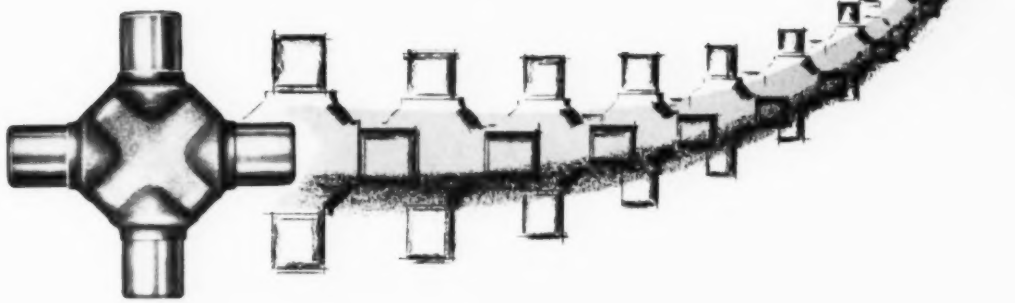
VAN NORMAN MACHINE

SPRINGFIELD 7, MASSACHUSETTS

MANUFACTURERS OF — Ram and Column Type Milling Machines, Cylindrical Grinders, Spline and Gear Grinders, Oscillating Radius Grinders, Special Production Grinders, Centerless Grinders.

Automotive Parts Manufacturer . . .

BOOSTS PRODUCTION more than 100%



WITH THE VAN NORMAN 2C DIVERSIMATIC CENTERLESS

A leading Detroit auto parts maker had a problem. He was producing close tolerance universal joints — very satisfactorily as to finish *but* only at the rate of from 70 to 170 per hour. He needed greater production.

His solution?

Van Norman 2C Diversimatic Centerless Grinders.

The result?

This manufacturer is now turning out 250 an hour. *And*, when these precision parts leave the Van Norman 2C Diversimatic Centerless, they are completely ground and gauged to tolerances of .0003 of an inch or less.

What made this possible?

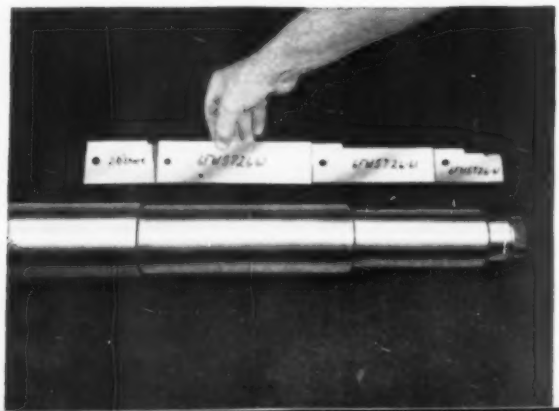
Van Norman design and engineering know-how which enabled them to produce a 2C Diversimatic, equipped with crush dresser, a special loading and indexing fixture, in conjunction with a special non-mar hopper belt loader and gauging device.

This is but one more example of how Van Norman helps tool engineers throughout industry reduce production costs. We welcome an opportunity to help *you* reduce your cost. Send in your specifications for a cost-saving Van Norman quotation.

COMPANY
A DIVISION OF
VAN NORMAN INDUSTRIES, INCORPORATED

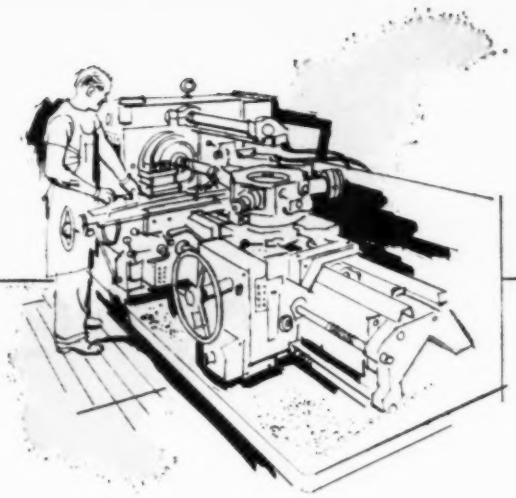
Don't wait . . . for extra profit install a Van Norman machine now!
They are available in many purchase plans . . . Outright sale . . .
Purchase on conditional sales contract up to five years . . .
Pay as you depreciate up to 10 years.
Conditional Sales Contracts not available to Export.

*T.M. Reg. U. S. Pat. Off.



Unique Section Template was one idea which Hobart tooling specialists came up with to reduce setup time and minimize template costs. A short template was made up to handle a range of shafts with similar ends. Various length middle sections could then be quickly inserted to obtain various lengths and shoulder locations. A three-section template is shown in use on the machine in upper photo. The interchangeability feature of the template sections is shown at left. Two pieces of this four-section template – the section marked "2⅛ Shaft" and the spacer section held in hand – are also used in the above setup.

CIRCLE 182 READER SERVICE CARD



AT HOBART BROTHERS COMPANY
TROY, OHIO

Warner & Swasey 2-A with contouring cross slide

- *Slashes setup time*
- *Combines auxiliary operations into one setup*
- *Produces shafts at 1948 cost levels*

HOBART BROTHERS CO.—a leading producer of arc welding equipment and aircraft ground-power units—faced a serious production bottleneck. Long setup time on their older turret lathes and excessive part handling time was crippling the small lot production of motor-generator shafts. Because their production scheduling for 77 different models of arc welders, 20 models of ground-power units, plus numerous specials, is tied directly to sales, lot sizes frequently had to remain small—usually from 1 to 20 pieces.

Hobart launched a three-pronged attack to solve the problem by:

1. Installation of a new Warner & Swasey 2-A Saddle Type Turret Lathe equipped with a hydraulically-controlled cross slide contour unit.
2. A creative tooling approach to reduce setup time.
3. A thorough time and motion study to insure efficient utilization of daily production time.

As a result, Hobart Brothers today are producing shafts at 1948 production costs!

Contributing to the success of this efficiency study and modernization program was their new contour cross slide equipped Warner & Swasey 2-A which permitted:

- **Setup time to be slashed—from 2 hours to 20 minutes.**
- **Combining of center drilling, facing and threading operations into a single, efficient turret lathe setup reducing part handling time.**
- **Production time savings averaging 35% because of higher horsepower and spindle speeds, and elimination of extra hex turret and square turret handling time. All diameters and grinding reliefs are produced directly from the template.**
- **Holding closer tolerances which reduced grinding time and extended grinding wheel life.**

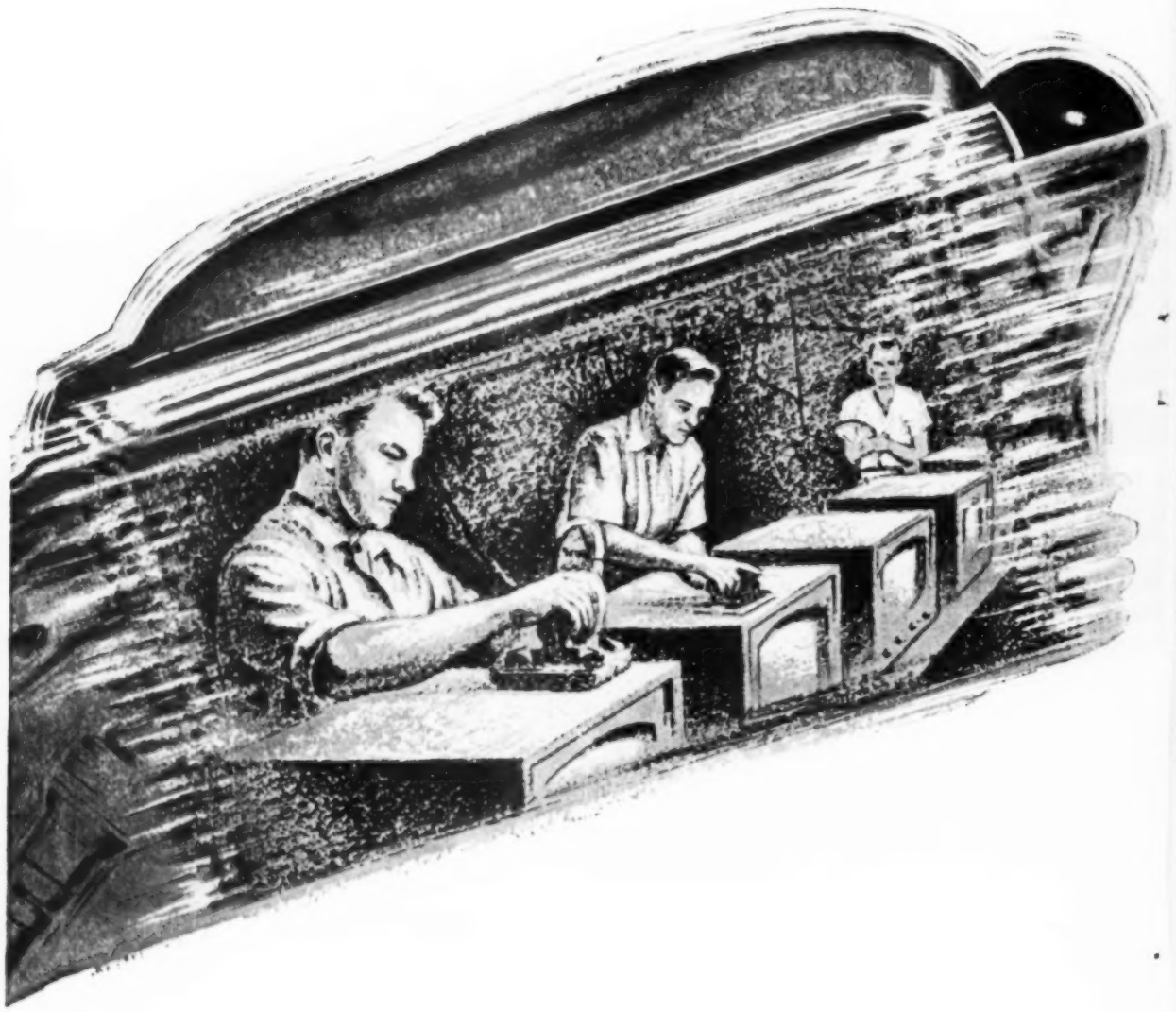
Check today with your Warner & Swasey Field Representative. He'll gladly tell you how the cost-cutting results of the "Hobart Story" can be a reality on your own operations.

WARNER & SWASEY
Cleveland
PRECISION MACHINERY SINCE 1880

YOU CAN PRODUCE IT BETTER, FASTER, FOR LESS...WITH A WARNER & SWASEY

It takes a lot of Grit

This "jitterbug"



to keep industry growing

performs in factories

Orbital sanding machines are widely used in furniture factories, by metal fabricators, and in automotive shops – wherever product surfaces are slick finished or polished.

The combination of motion and the cutting action of the coated abrasive produces the satin finish on fine furniture . . . the glisten and sparkle on your automobile or toaster. And American ingenuity continues to put the "jitterbug" to work on many odd tasks – from smoothing taped wallboard joints to removing paint.

Product and methods research has brought leadership in coated abrasives to Behr-Manning – and it has brought increased production and lower costs to industry and their customers. That is why Behr-Manning supplies an extraordinary variety of coated abrasives tailored to fit practically every standard machine and need – for industry and the home craftsmen.

In one year, Behr-Manning makes more than 180,000,000 sheets of sandpaper and over 20,000,000 abrasive belts – plus millions of discs, rolls, and other coated abrasive specialties.

The sign of the Bear means a better product . . . and better production

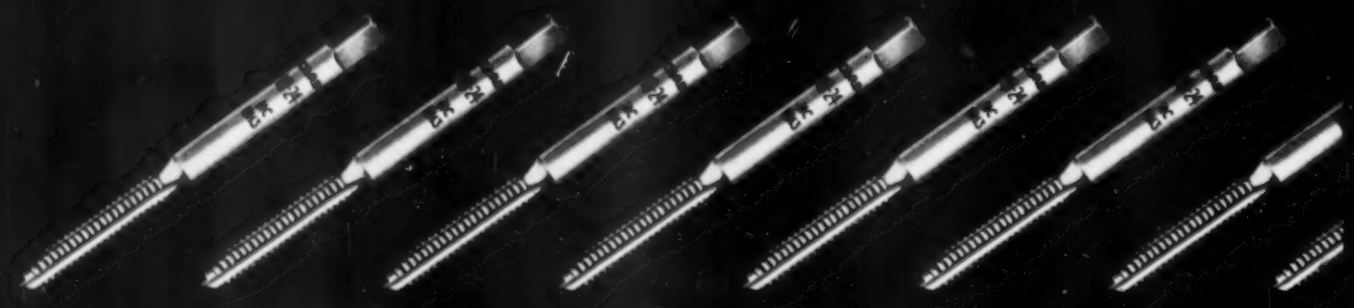
BEHR-MANNING CO.

TROY, NEW YORK – A DIVISION OF NORTON COMPANY

BEHR-MANNING PRODUCTS: Coated Abrasives • Sharpening Stones • Pressure-Sensitive Tapes
NORTON PRODUCTS: Abrasives • Grinding Wheels • Grinding Machines • Refractories • Electrochemicals
In Canada: Behr-Manning (Canada) Ltd., Brantford For Export: Norton Behr-Manning Overseas Inc., Troy, N. Y., U.S.A.

NORTON ABRASIVES®

When you see uniformity, remember . . .



With Card machine screw taps you get uniformity

Your production's consistent ...because Card taps are uniform

. . . And they give you "quality in details" . . . a feature you'll find only in the finest cutting tools. For example, the name, size, and type of every Card machine screw tap is *rolled* into the shank during manufacture. This deep, highly legible impression lasts throughout subsequent grindings . . . simplifies identification in the crib . . . permits easy reordering. Your Card technical man has the facts about all the "extras" that make Card machine screw taps the choice of shopmen everywhere. S. W. CARD DIVISION, Mansfield, Mass. Card Warehouses: Atlanta, Chicago, Detroit, Fort Worth, Los Angeles, New York, San Francisco.

CARD

DIVISION OF UNION TWIST DRILL COMPANY

— Serving you through the best distributors from Coast to Coast

CIRCLE 186 READER SERVICE CARD

If you use drills as much as trucks use tires...

Ordering Union drills will cut your production time and costs

Visit the Union Booth 309 at the Triple Mill Convention in Dallas, Texas. May 13-15.

The more you use drills the more you need Union

Union drills are made in every type and size you need, with every advantage you need — in materials, design, workmanship and performance — to save you time and money on every drilling job. In your plant, as in plants throughout the country, a Union technical man will be glad to prove that production time and costs can be cut with Union drills, end mills, milling cutters, gear cutters, reamers, hobs, carbide tools and inserted blade cutters. **Available nationally through Union Distributors.** Full stocks are maintained in Atlanta, Chicago, Detroit, Fort Worth, Los Angeles, New York City and San Francisco.

UTD

UNION

TWIST DRILL COMPANY, Athol, Massachusetts

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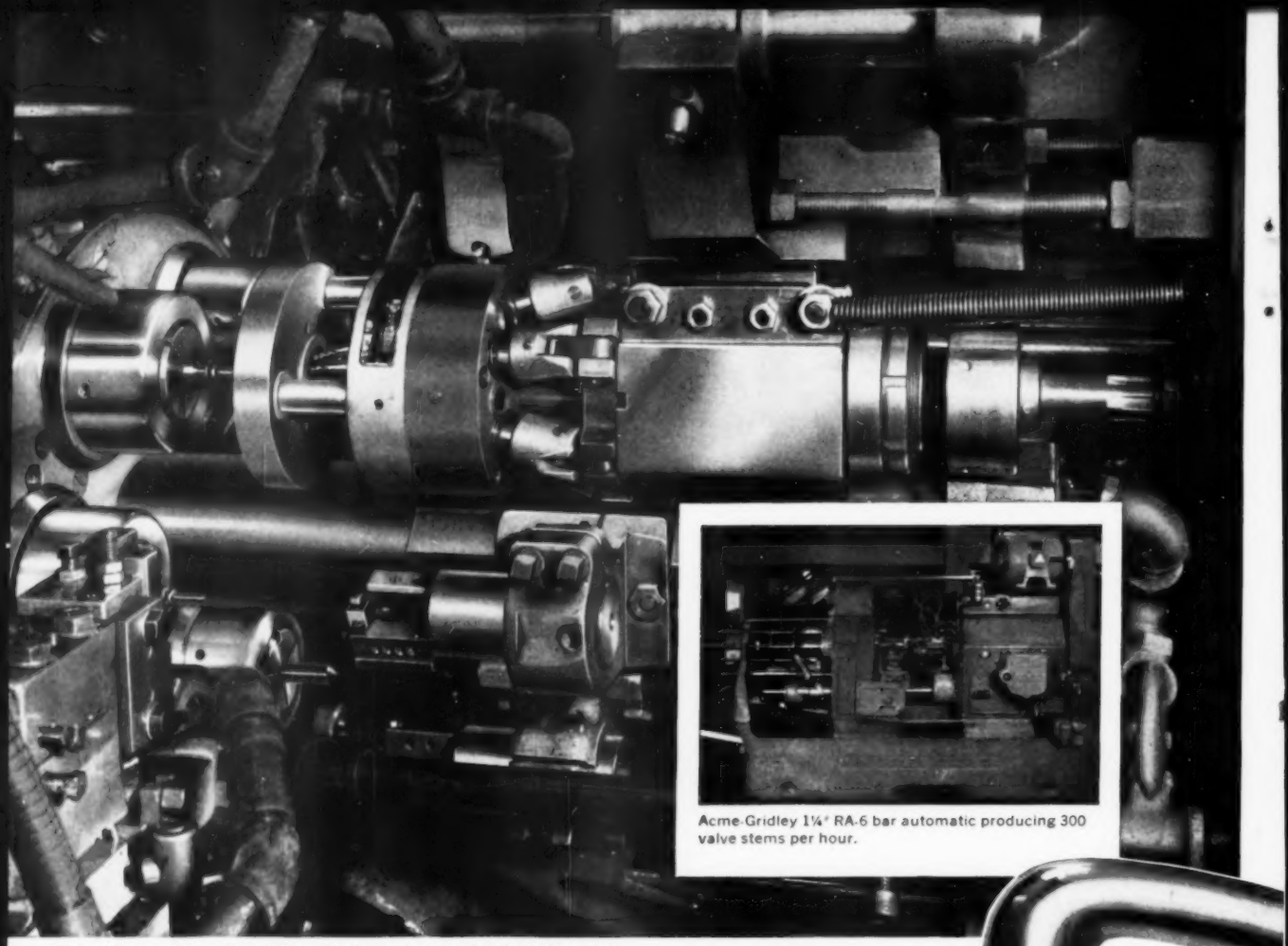
Visit the Card Booth 307 at the Triple Mill Convention in Dallas, Texas • May 13-15

CIRCLE 187 READER SERVICE CARD



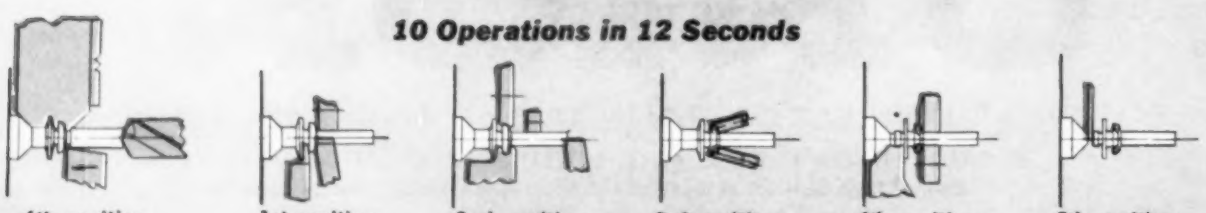
Acme-Gridley 1¼" RA-6 bar automatic producing 300 valve stems per hour.

Special Namco-designed multiple end milling attachment in the 3rd position.

When Tolerances and Finish Looked Economically Impossible

AMERICAN-STANDARD TURNS TO ACME-GRIDLEY...

10 Operations in 12 Seconds



6th position
Rough form rear —rough turn stem —spot drill

1st position
Finish turn stem face large diameter

2nd position
Shave—face and chamfer stem end

3rd position
Stop spindle— mill six slots

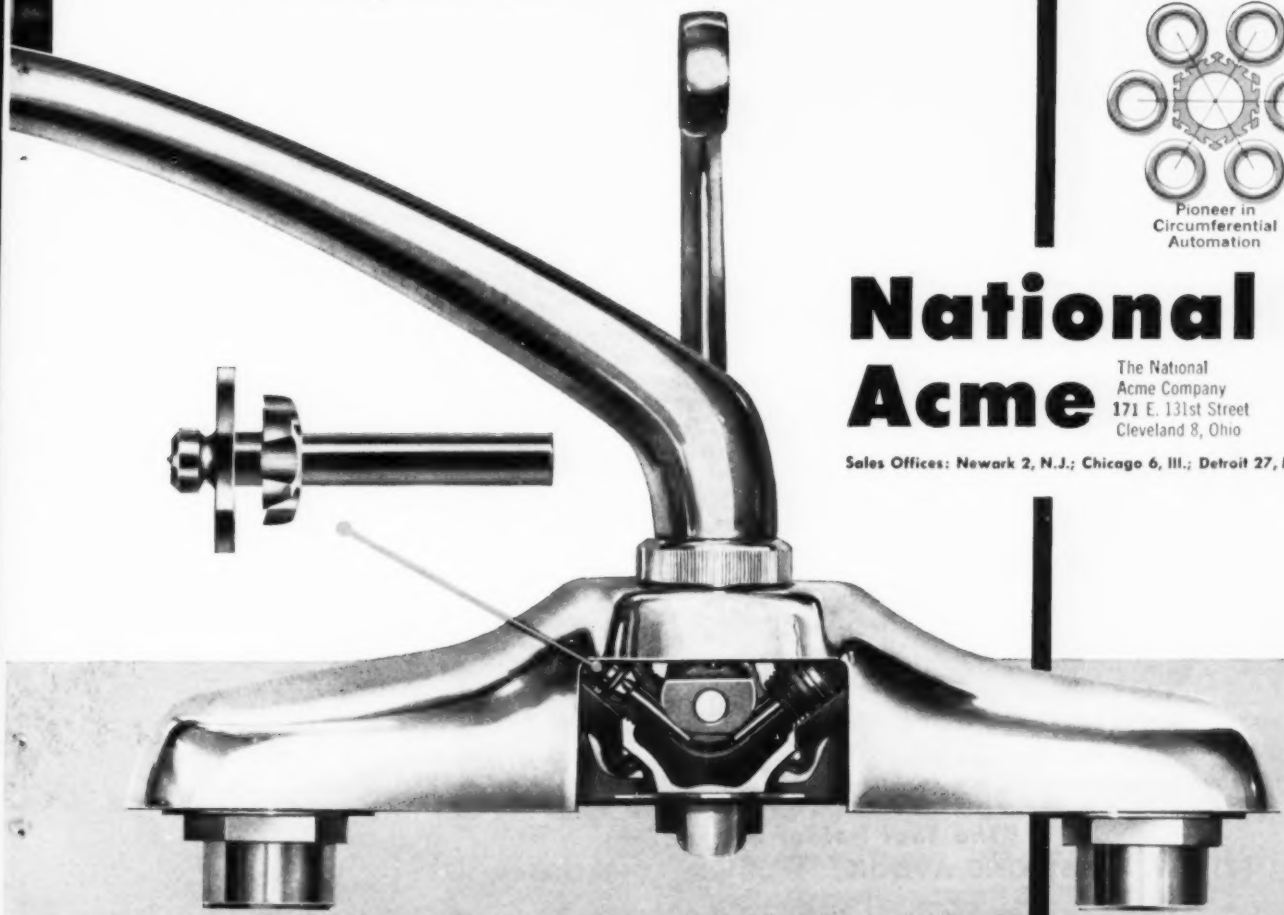
4th position
Start spindle— burnish stem— form back end

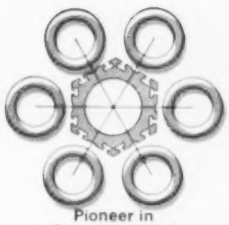
5th position
Cutoff

COMPLETED IN A SINGLE SETUP . . . this hyseal valve stem is a vital component in American-Standard's single-lever mixing faucet. Production by other processes would have meant a two-piece assembly. It would have been economically impossible to meet the high standard of quality and exacting tolerances maintained on this company's products.

Ten operations, including multiple end milling of six half-holes on a 15° angle, were performed on this 303 stainless steel piece in 12 seconds. Rigid specifications required a 20 microinch finish and limits of .002 t.i.r. between seating surface and end of valve stem.

Advanced spindle stopping design and the inherently accurate indexing of Acme-Gridleys, assure proper alignment of the work with the standard and special tool attachments. This, together with wide open tooling zones and independently operated tool slides, helps assure the solution of "impossible" jobs at National Acme. Write or ask one of our representatives for the complete story on the industry's most modern approach to your cost reduction problems.





Pioneer in Circumferential Automation

National Acme

The National Acme Company
171 E. 131st Street
Cleveland 8, Ohio

Sales Offices: Newark 2, N.J.; Chicago 6, Ill.; Detroit 27, Mich.

New Positive Rake
ARMSTRONG
Carbide Insert TOOL HOLDERS

See us at
our BOOTH No. 308
ASTE SHOW

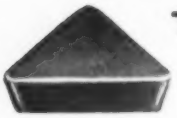
with proven ARMSTRONG Design Features

Rapid Indexing—always easily accessible from top or bottom sides . . . reduces down time.

Replaceable Seat of Hardened Tool Steel—prevents damage to shank.

Huskier shanks of Heat Treated Alloy Steel—for added strength and rigidity.

Shank Styles for Use in both Conventional and Open Side Tool Posts.



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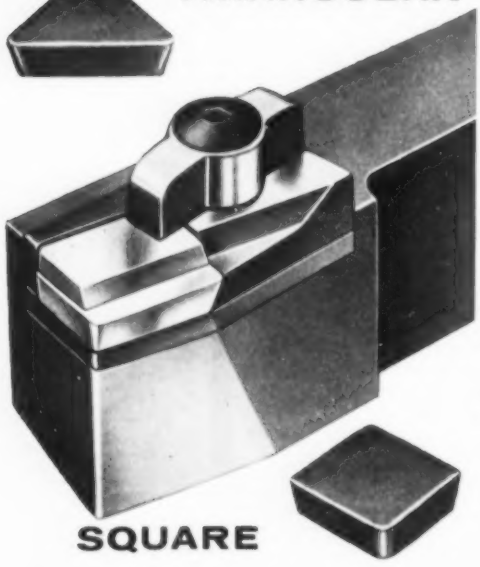
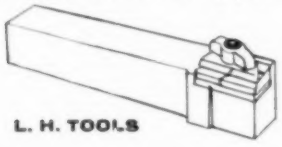


SQUARE

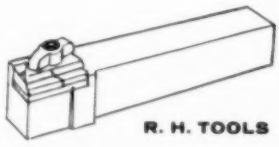
These positive rake Carbide Insert Tool Holders are for every day tool room and production turning on engine lathes, turret lathes and screw machines. They permit increased cutting speeds associated with the use of carbides and they entirely eliminate carbide tool grinding.

Low cost positive rake ARMIDE "throw away" Inserts provide three or four cutting edges per insert. Triangular inserts have three, square inserts four cutting edges. They are available in three grades of ARMIDE: 350, 370 or 883.

Buy positive and negative rake Carbide Insert Tool Holders which carry the ARMSTRONG trade mark; leader in tool holders and cutting tools for over sixty years.



L. H. TOOLS



R. H. TOOLS

ARMSTRONG BROS. TOOL CO.

"The Tool Holder People"

5215 W. ARMSTRONG AVENUE CHICAGO 46, ILL.

Buy ARMSTRONG TOOLS from your Industrial Distributor

Your best buy in small surface grinders

built to Landis precision grinder standards

- low first cost
- dependable accuracy
- unit construction for easy inspection and maintenance
- big machine capacity

  12" capacity under a 12" wheel

  a full 150 square inches of surface area

  grind deep with accuracy—3½" under head to bottom of wheel

Send for new catalog of Landis Abrasive Surface Grinders

ABRASIVE
precision surface grinders

a product of
LANDIS TOOL
world's largest manufacturer of precision grinding machinery
WAYNESBORO, PENNSYLVANIA

New SKINNER DUCTILE IRON TROUGH VISES

are more rigid, stronger . . . and tougher!

● Thanks to the use of a unique new metal, ductile iron, these new Skinner milling machine trough vises have *extra* strength to resist cracking, *extra* toughness to take abuse, *extra* hardness to withstand heavy blows, and *extra* rigidity for extreme accuracy and holding power. They vibrate less, too . . . reducing scrap and tool breakage. You can expect these new Skinner D-I-T vises to hold up longer in service than any other construction and to require a minimum of maintenance.

The holding capacity of these vises is equal to the full width of the jaws. And the precision-machined jaws are rugged enough to hold work under the severest conditions. A flat, smooth body keeps chips from getting under the movable jaw. And a large trough guides the coolant to return – keeps it from slopping over. A square lock construction provides additional rigidity.

Jaw widths: 4", 5", 6", 7", 8". Optional swivel base for setting vise at any angle through 360° in a horizontal plane.

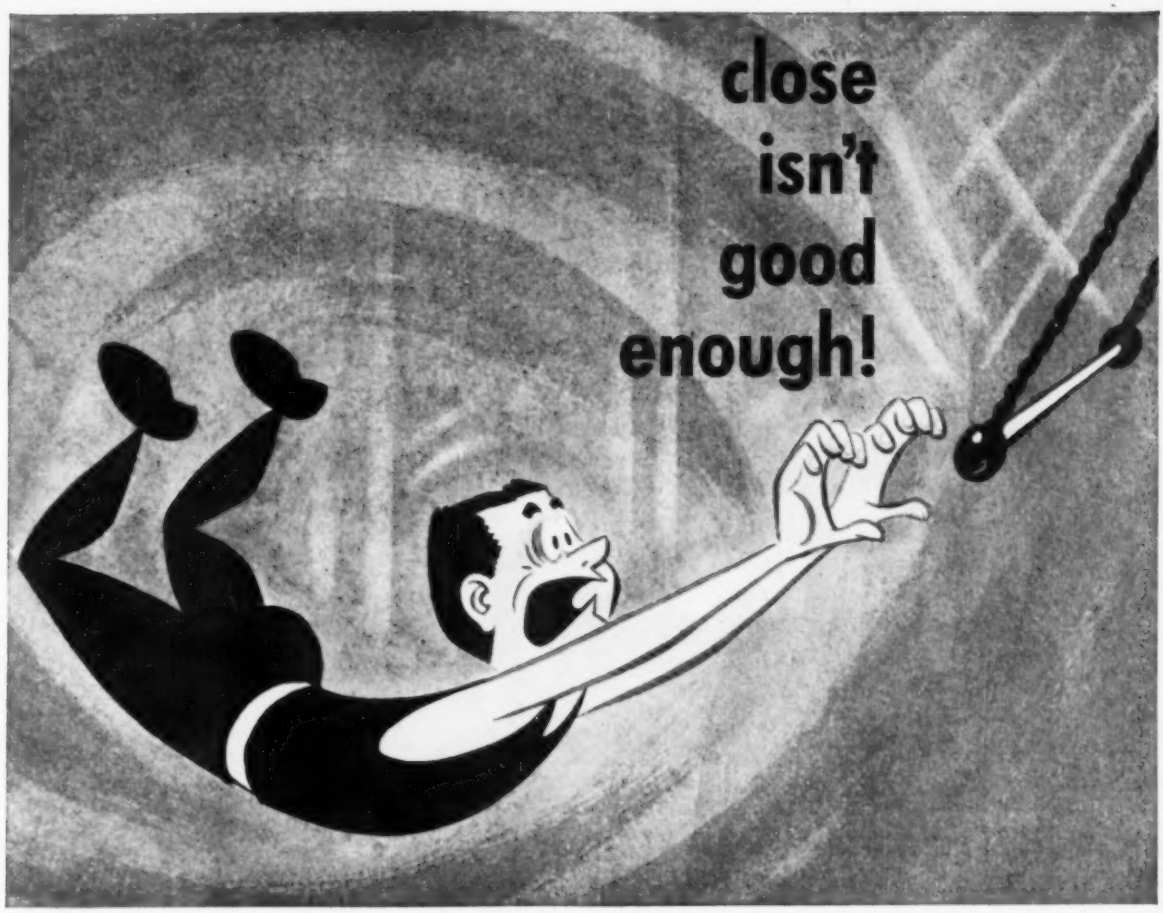
Skinner Vises and Chucks are available nationally from leading Industrial Distributors, Machine Tool Builders and Dealers. For complete information, contact a Skinner Representative or write us at Dept. 104

SKINNER CHUCK ®

SKINNER VISES

THE CREST OF QUALITY

THE SKINNER CHUCK COMPANY • NEW BRITAIN, CONNECTICUT



How close do you specify balancing tolerances for your rotating parts? Are they close enough? Can your balancing equipment meet them accurately, quickly, or do you depend on your operator's judgment? It's worth knowing because it costs far less to balance precisely than to correct product failures and regain lost customer confidence once a breakdown occurs "in the field."

In balancing, either it's right or it isn't. For example, consider the accuracy of angular location of unbalance. You make the right *amount* of correction—but place it only 5° off the required location and you still have 9% of the original unbalance left. This means vibration—and eventual trouble.

Gisholt Balancers assure you of highest accuracy in locating and measuring unbalance, enable you to correct in smaller increments—in both single and or two-plane balancing operations. And they do it faster, easier, using unskilled personnel.

Test before you buy. To help you *specify* the balancing equipment best suited to your needs, Gisholt offers a new booklet, "Performance Tests for Balancing Machines." No *reliable* supplier of balancing machines will refuse to cooperate in these tests. For your free copy, call your Gisholt Representative or write us.

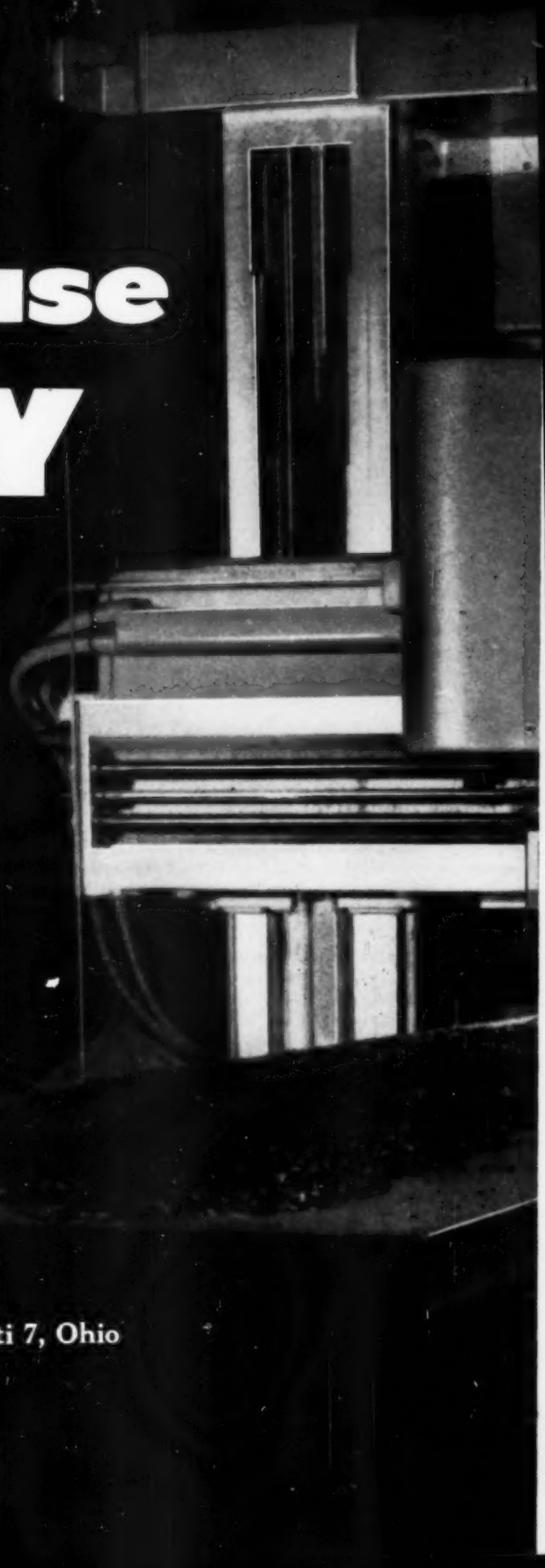
This Gisholt 1S Balancer is used to locate and measure unbalance in Dynamotor armatures. The direct reading amount meter is calibrated so that one meter unit equals ⅛" length of ⅛" diameter solder. Work is corrected in left and right correction planes, using simple soldering iron, and rotated again to inspect for balance. Production—by the female operator shown—over 40 parts per hour.

GISHOLT MACHINE COMPANY
Madison 10, Wisconsin

Investigate Gisholt's Extended Payment and Leasing Plans

Turret Lathes • Automatic Lathes • Balancers • Superfinishers • Threading Machines •
Factory-Rebuilt Machines with New-Machine Guarantee

powerhouse by GRAY

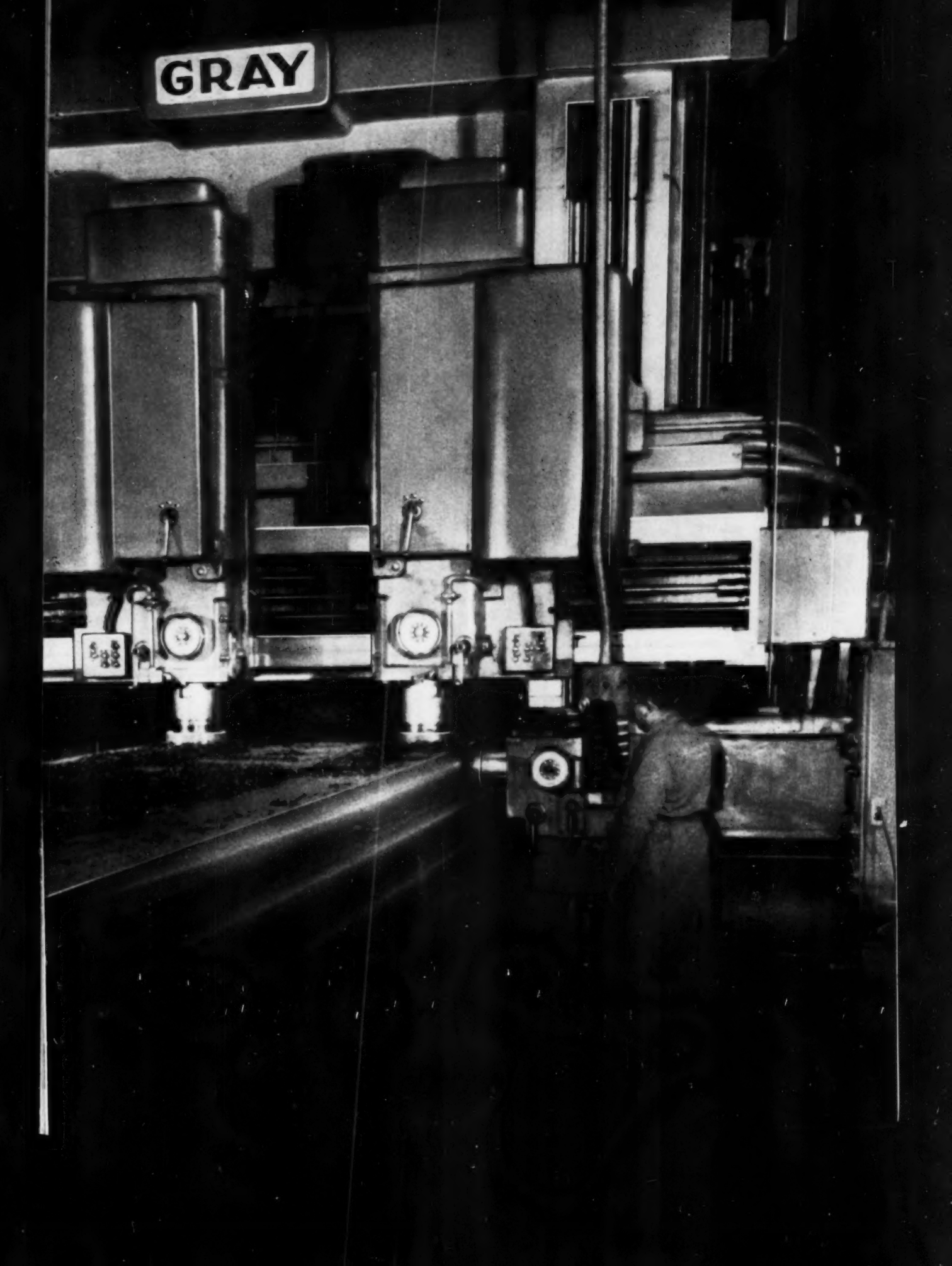


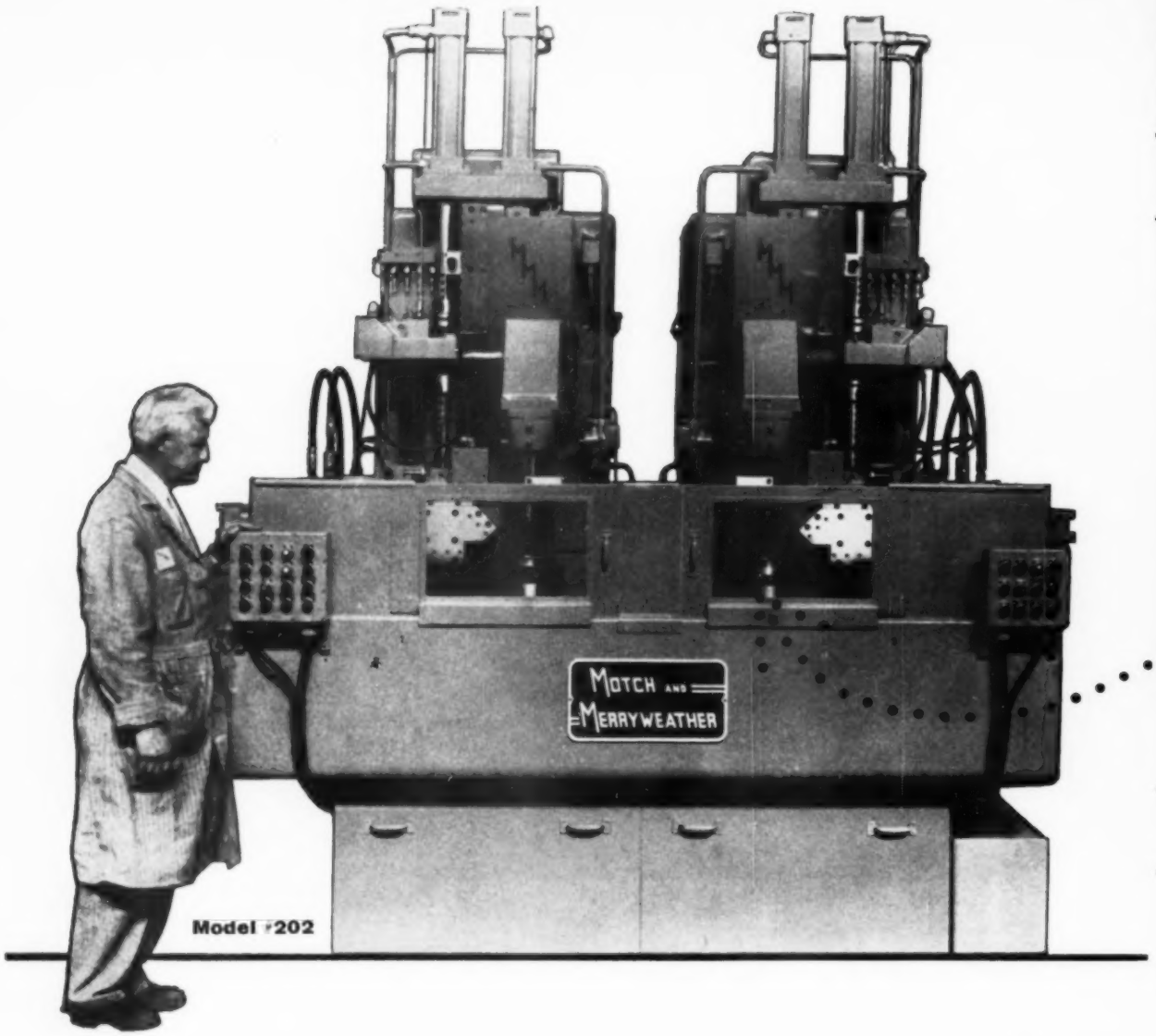
When four 75 HP unit heads pour 300 HP into a cut the chips fly with a cost cutting ring. This 108"x 96"x 30' GRAY was recently installed at The Kearney & Trecker Co., Milwaukee, where real milling is well understood. This renowned machine tool builder required:

cost cutting power
highest precision
unquestioned reliability
ease of control

It all added up to a new Gray,
further proof that
Quality doesn't cost . . . it pays.

The G. A. GRAY Co., Cincinnati 7, Ohio


GRAY



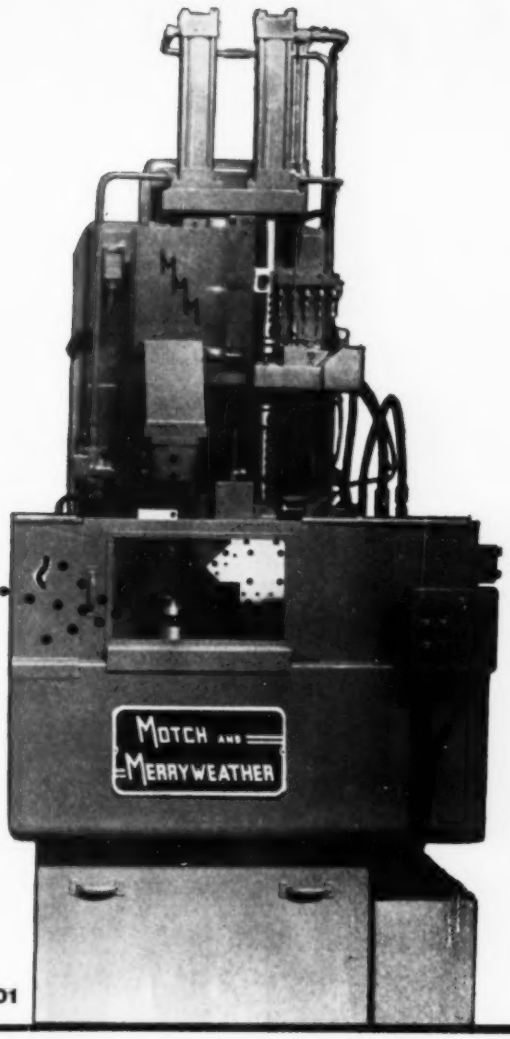
MOTCH & MERRYWEATHER'S

...add flexibility to standard machining operations

Here's a machine tool designed for precision turning, boring and facing operations with versatility for long and short run production jobs. Features:

- **spindles will accommodate any type chuck including air operated draw bar (20" swing) —spindle speeds adjustable.**
- **automatically-lubricated tool slides.**
- **slide ways of hardened and ground steel with tapered gibs for accurate alignment and easy adjustment.**
- **hardened adjustable slide stops.**
- **hydraulic or cam-actuated slide-feed, rapid traverse and rapid return.**

Boring, facing, and turning—to 20″—is accurately handled on the new M&M Series #200 Vertical Turners.



Model #201

#200 VERTICAL TURNERS

- **separate controls for each spindle and slide unit to permit their independent operation on two-spindle machine (single spindle machines available).**
- **on four-spindle, two column machine, spindles are controlled in pairs, separate controls for each pair.**
- **"building block" design for easily-made tooling and slide changes to accommodate a wide variety of work.**
- **design features accessibility for simple, speedy maintenance of spindles, motors, hydraulic cylinders and/or cams and slides for minimum downtime.**
- **three position automatic turret available for boring, counter-boring, etc.**

We can show you, in detail, how this new adaptable metal-working machine will improve your present machining operations. Call your nearby Motch & Merryweather representative, or write: Motch & Merryweather Machinery Company, 1250 East 222nd Street, Cleveland 17, Ohio.

MOTCH AND MERRYWEATHER

Machine Tool Manufacturing Division
Cutting Tool Manufacturing Division
CLEVELAND
Avey Division, Cincinnati

BUILDERS OF AUTOMATIC PRECISION CUT-OFF, MILLING, DRILLING AND SPECIAL MACHINERY

ACCURACY

When You Buy from Your Local P&W Cutting Tool Specialist

The men you'll do business with are experienced, factory-trained cutting tool specialists . . . not just "order-takers." Their expert advice will insure the right tools to do your jobs faster and better. You'll be sure to get the biggest return on every dollar spent, because P&W Cutting Tools are QUALITY from start to finish – last longer and produce more, accurately finished pieces.

Expert engineering service, quality, dependability, and availability are all yours for the asking at any one of these P&W Branch Offices. Why not phone or call today?

BIRMINGHAM, Alabama
Phone TRemont 1-0482
BOSTON, Massachusetts
Phone Kirkland 7-5875
BUFFALO (Tonawanda), New York
Phone UNiversity 8804
CHARLOTTE, North Carolina
Phone EDison 2-7774
CHICAGO, Illinois
Phone HUmboldt 9-1626
CINCINNATI, Ohio
Phone PArkway 1-3112
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DALLAS, Texas
Phone FLeetwood 2-1709
DENVER, Colorado
Phone DExter 3-4418
DETROIT, Michigan
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HOUSTON, Texas
Phone WAlnut 6-9643
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MILWAUKEE, Wisconsin
Phone GLenview 3-7650
NEW YORK CITY (Flushing), New York
Phone INdependence 1-6363
PHILADELPHIA, Pennsylvania
Phone WAlnut 2-1140
PITTSBURGH, Pennsylvania
Phone POplar 1-7212
PORTLAND, Oregon
Phone ATlantic 7-1867
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Phone LUdlow 6-6212
ST. LOUIS, Missouri
Phone CEntral 1-6770
SAN FRANCISCO, California
Phone MArket 1-7363
SEATTLE, Washington
Phone MAin 4-1141
SYRACUSE, New York
Phone HOward 3-8214
WEST HARTFORD, Connecticut
Phone ADams 3-7561

Plus resident specialists in: ALBANY, New York; FLINT, Michigan; INDIANAPOLIS, Indiana; MINNEAPOLIS, Minnesota; ROCKFORD, Illinois; SPRINGFIELD, Ohio; TOLEDO, Ohio; WICHITA, Kansas

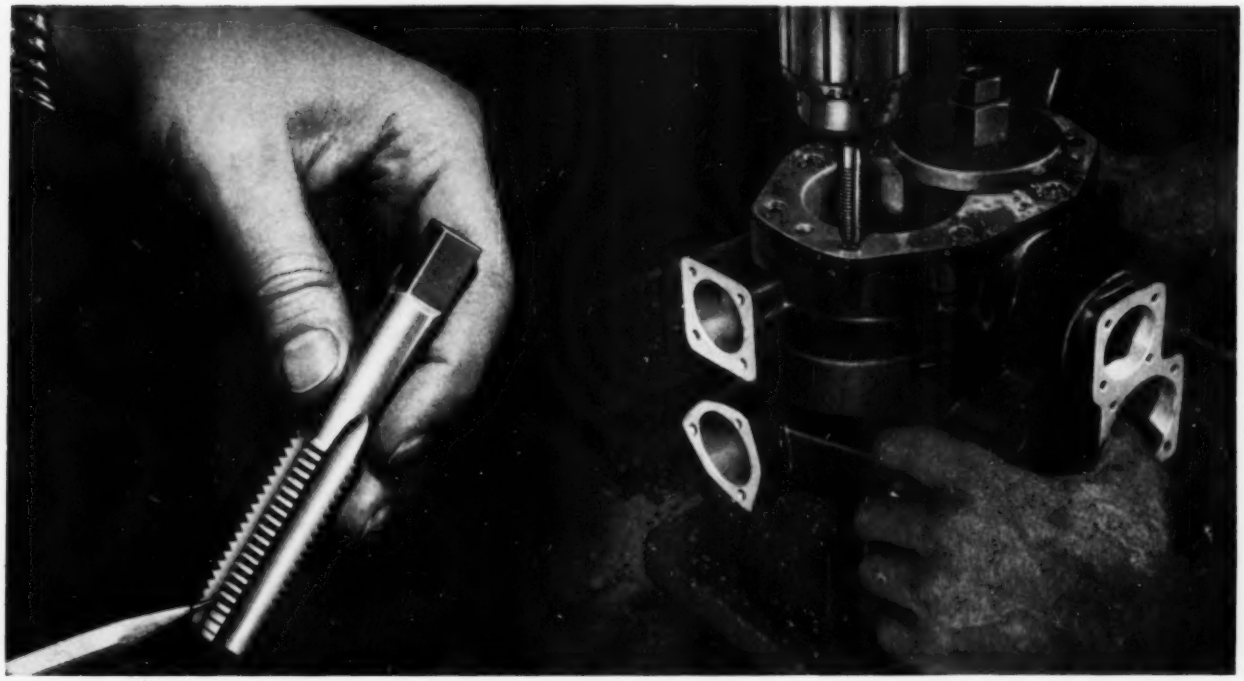
PRATT & WHITNEY

FIRST CHOICE FOR ACCURACY

MACHINE TOOLS • GAGES • CUTTING TOOLS

ASSURED...

COSTS REDUCED WHEN YOU BUY PRATT & WHITNEY TAPS



These Pratt & Whitney taps produce more accurately threaded holes per tool, because they ARE accurate . . . with squares, shanks, threads, OD's, and chamfers all precision machined and ground on centers.

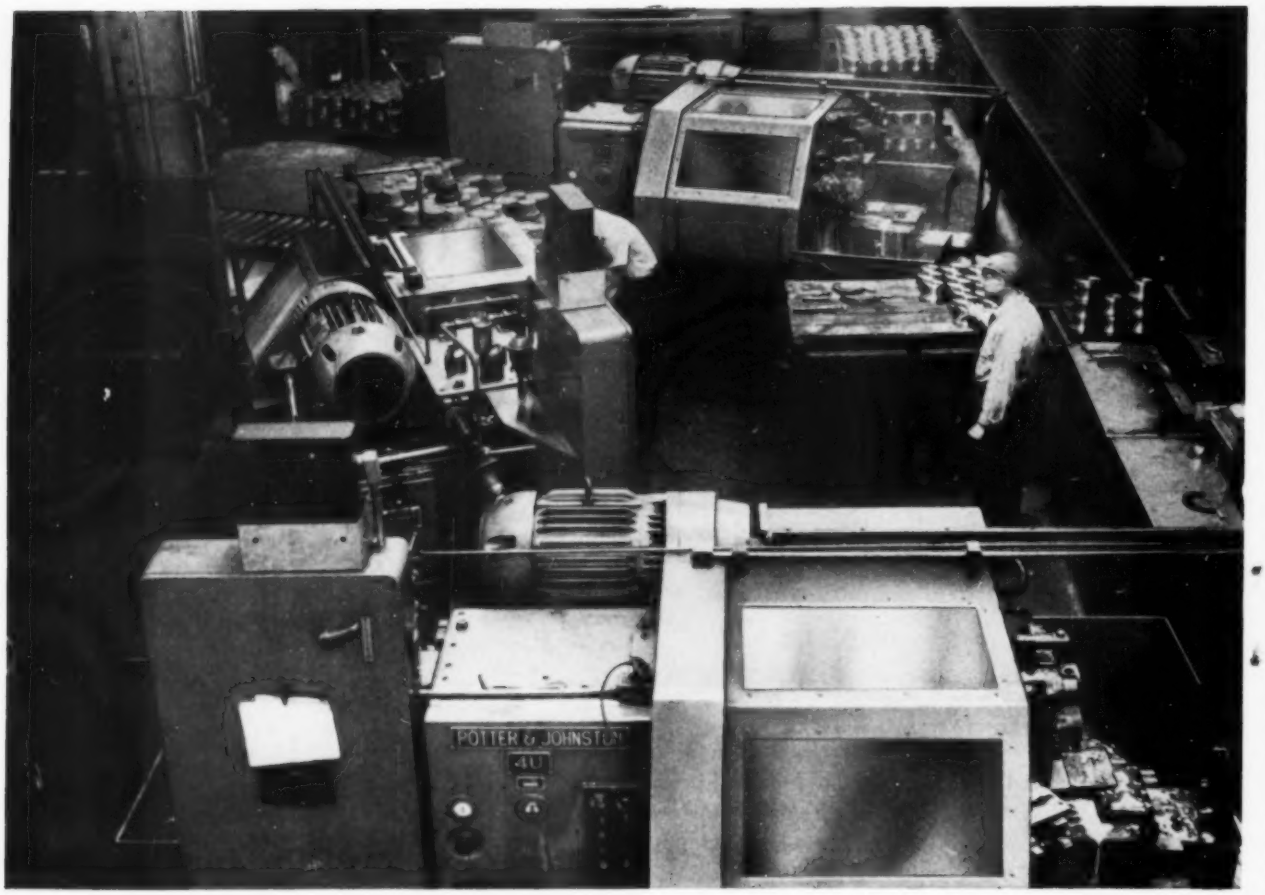
Whether it's taps or other cutting tools, you'll save time and money when you buy from your local Pratt & Whitney Branch Office. You can be sure that all P&W Cutting Tools are *quality* from start to finish . . . cost you less in the long run, because they run far longer before replacing or re-grinding. Equally important, you'll be doing business with men who are experienced, factory-trained cutting tool specialists. You can always count on their expert advice to help you pick the best tools for your specific requirements.

YOUR ANNUAL INVESTMENT IN CUTTING TOOLS ADDS UP TO A LOT OF MONEY . . .

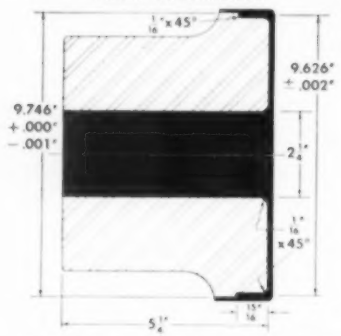
so phone your nearby P&W Branch Office today and ask a P&W Specialist to show you how to reduce your cutting tool costs. Pratt & Whitney Company, Inc., 11 Charter Oak Boulevard, West Hartford, Conn.

TAPS • THREAD ROLLING DIES • THREAD MILLING CUTTERS • MILLING CUTTERS • END MILLS • REAMERS • KELLERFLEX BURS • KELLER CUTTERS

Here's how P&J did this job

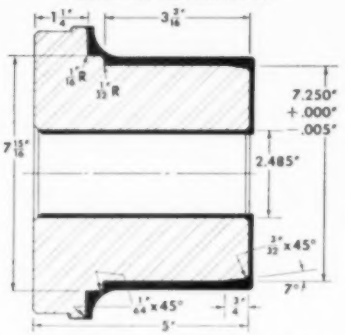


FIRST OPERATION



Heavy lines indicate machined surfaces.

SECOND OPERATION



Heavy lines indicate machined surfaces.

Automatics IN HALF THE TIME

. . . and also reduced costs, improved quality and saved plant floor space

Specializing in the production of components for heavy machinery, a Milwaukee firm supplies a line of flanged hubs for road building and other heavy-duty equipment. Machined from 92-pound steel castings, these hubs require 24 separate cuts, with the removal of nearly 31 pounds of solid metal. To produce these hubs, the company had been using 2 hand-operated turret lathes – plus drill presses and other machines. Three or four operators were required. Machining time was 12.6 minutes. Accuracy, concentricity and finish were unsatisfactory. After considering 4 other makes of automatics, 2 P&J Automatic Turret Lathes were purchased.

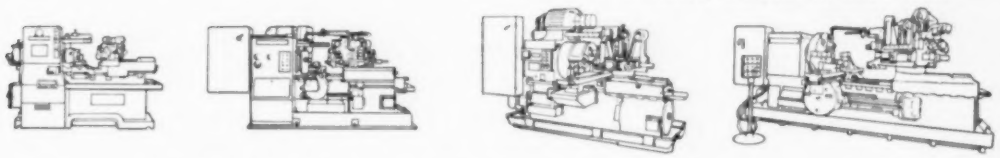
P&J Cuts Time from 12 Minutes to 6!

Now, using the P&J Machines, hubs are completely machined in 2 fully automatic cycles . . . in just 6 minutes! Inaccuracy has been eliminated. Secondary operations have been eliminated, and floor space has been reduced by 66%. Maintenance has been reduced by 15%. Since 1 man operates both P&J Automatics, 2 to 3 trained men have been released for other important work.

Planned Production by P&J

A switch from hand machines to P&J Automatics helped this company save time and money — and it can do the same for you! Call the Pratt & Whitney Branch Office in your area today and ask the P&J Representative to recommend a production plan or write direct to Potter & Johnston Company, 11 Charter Oak Boulevard, West Hartford, Conn.

Formerly Pawtucket, Rhode Island

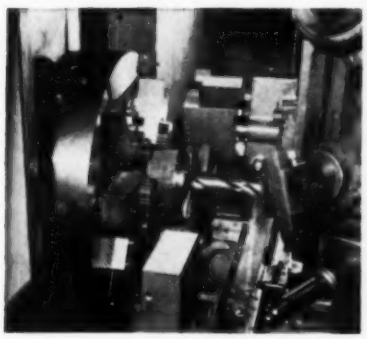


. . . AUTOMATIC TURRET LATHES WITH CHUCK SIZES FROM 6 TO 42 INCHES . . .

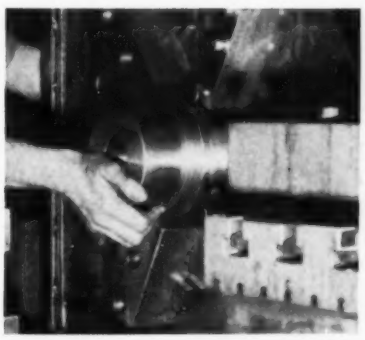
POTTER & JOHNSTON

SUBSIDIARY OF PRATT & WHITNEY COMPANY, INC.

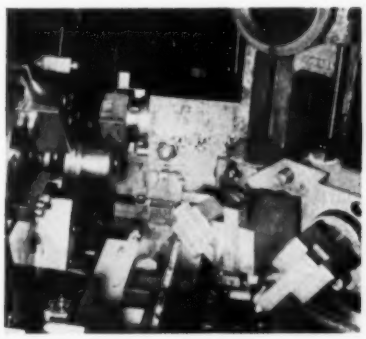
PRECISION PRODUCTION TOOLING SINCE 1898



REMOVING 31 POUNDS OF METAL . . . from the 92-pound steel casting, work is chucked in the first machine where 10 cuts are performed.



COMPLETING A PART EVERY 6 MINUTES . . . After the first operation, part is chucked in the second machine where the remaining 14 cuts are completed.



TOOLING DESIGNED BY P&J . . . plays an important part in the 50% machining time reduction. Accuracy and concentricity are dependably maintained.

MACHINE THE UNMACHINABLE!

THERE'S A SHEFFIELD CAVITRON ULTRASONIC MACHINE TOOL FOR YOUR SPECIFIC JOB

Series 2400A machines
an area up to 9.613 sq. in.
Series 200B machines
an area up to 0.196 sq. in.
Series 1000B machines
an area up to 3.142 sq. in.
Series 100A machines
an area up to 0.038 sq. in.
Series 1000PK machines
an area up to 3.142 sq. in.

Each of these ultrasonic tools economically machines the very hard and very brittle materials such as hardened tool steel, cemented carbide, cermets, silicon, germanium, aluminum oxide and others.

Each of these machines is used to produce dies, transistor components, electronic elements, precision machine parts, servo valves and other products.

Each of these machines drill, contour, slice, dice, coin and engrave.

All have these operating advantages:

- Fast cutting for high production
- Work to close tolerances with excellent surface finishes
- Low tool cost — minimum of machine maintenance
- High precision with semi-skilled operators
- No thermal cracks—no localized annealing
- Provide the designer a freer choice of materials

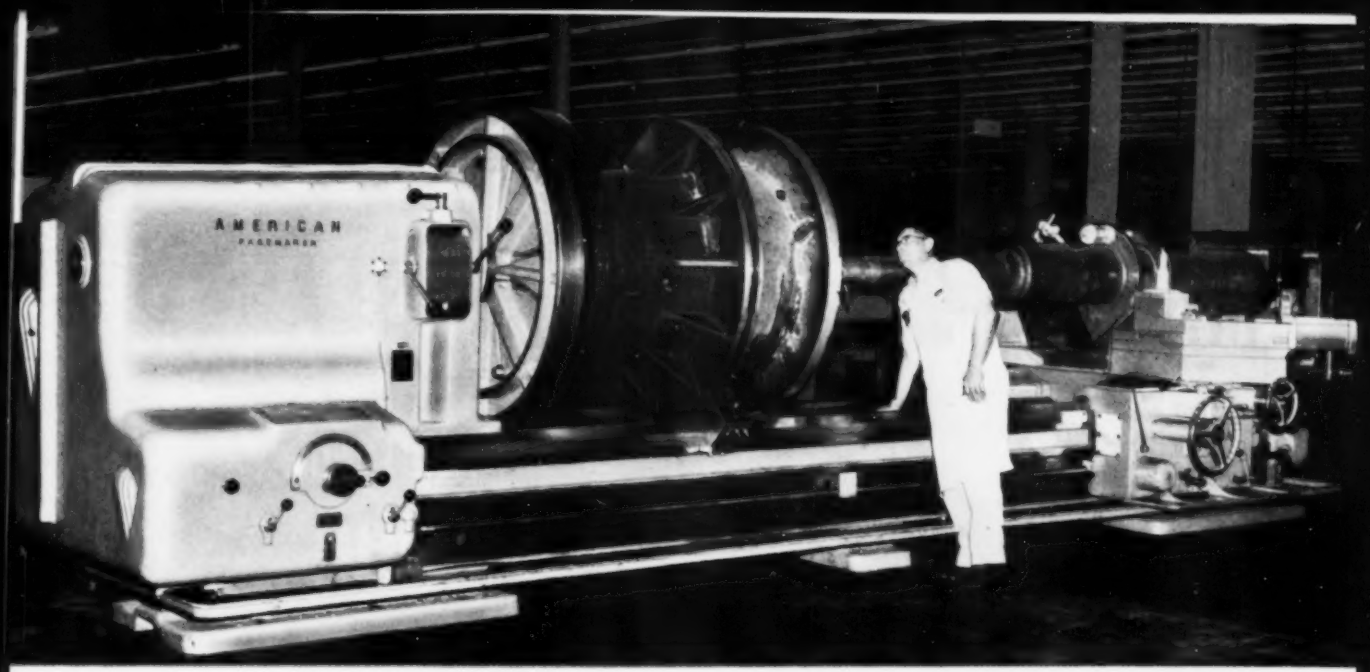
For detailed specifications, write to the Sheffield Corporation, Dayton 1, Ohio, U.S.A., Dept. **7.**

the **SHEFFIELD** *corporation*

of Bendix Aviation

manufacture and measurement for mankind

8221



HERE'S THE *VISUAL* ANSWER!

Any question about the capacity of "AMERICAN" Lathe Spindle bearings or the stiffness of "AMERICAN" Spindles is certainly answered by this illustration.

Here is a 40" "J-9" "AMERICAN" Deluxe Model Hydraulic Duplicating Lathe (one of three, 40" "J" "AMERICANS") in the Charlotte, North Carolina plant of the Douglas Aircraft Company, Inc., boring a 54" diameter bulge die weighing five (5) tons. This illustration shows an ingenious roller rest made by Douglas but on many operations no steady rest is used.

This is a 60 horse power lathe with spindle and spindle bearings of tremendous capacities, consequently is ideally adapted to "elephant" operations of this nature and there are other exclusive design features contributing to the excellence of this big lathe, such as the extremely rigid 4-vee bed; the brand new massive 7½" diameter spindle tailstock; the patented three bearing, triple drive spindle; its 100% anti-friction construction and full automatic oiling.

The many ultra modern and superlative features of "AMERICAN" Deluxe Model Pacemakers are described and thoroughly illustrated by bulletin No. 150. May we send you one?

THE AMERICAN TOOL WORKS CO. Cincinnati 2, Ohio, U. S. A.

LATHES AND RADIAL DRILLS

CIRCLE 203 READER SERVICE CARD

NOW MORE THAN EVER

MARVEL HIGH SPEED EDGE HACK SAW BLADES

should be **YOUR FIRST CHOICE**

This is no time for "second-best" performance from your hack sawing machines. Today, every cut you make on a hack saw should be done as quickly, accurately, and economically as possible.

The *blades* you use can often mean the difference between mediocre work and top performance from your hack sawing machines. Here are 3 big advantages unbreakable MARVEL High-Speed-Edge Hack Saw Blades can bring to your cutting-off operations:

1 HIGHER PRODUCTION . . .

MARVEL High-Speed-Edge Blades are shatterproof and can be worked harder and faster than any other blade. They will withstand the highest speeds and heaviest feeds attainable on any hack sawing machine with complete safety. Machine operators working with MARVEL Blades naturally apply greater tensions, feeds, and speeds because they know they are safe from personal injury accidents. The result is faster cutting-off.

2 GREATER ACCURACY . . .

MARVEL Blades can be safely tensioned from 200% to 300% more taut than ordinary blades. Higher blade tensions produce greater rigidity of the high-speed-steel cutting edge, resulting in maximum attainable accuracy of cut-off blanks.

3 LONGER BLADE LIFE . . .

Each MARVEL High-Speed-Edge Hack Saw Blade is triple tempered to assure maximum toughness of the cutting edge. MARVEL Blades not only give you longer life, they assure a more efficient cutting life and lower blade costs.

Why gamble? Demand MARVEL Blades by name, and be sure you're getting the best blades on the market. Leading Industrial Distributors have them in stock.

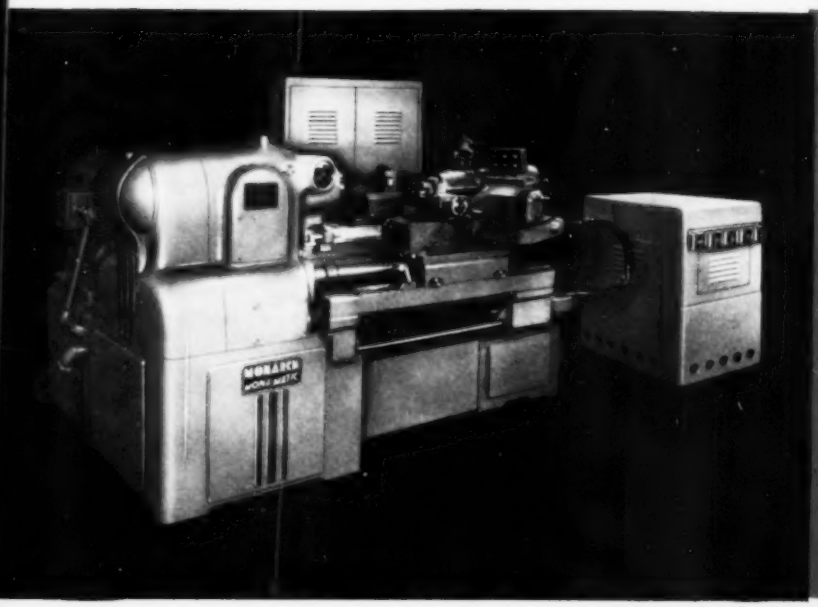
B-1123

Write for the new MARVEL Cutting Tool Bulletin and the name of your nearest MARVEL Distributor.

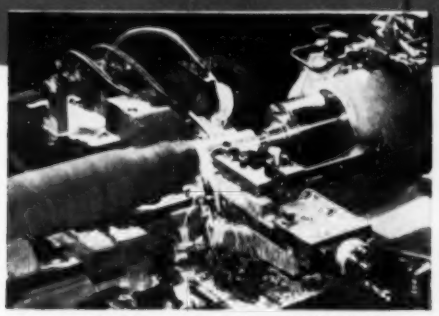
ARMSTRONG-BLUM MFG. CO.
5700 BLOOMINGDALE AVE. • CHICAGO 39, ILLINOIS

Metal Cutting **MARVEL SAWS**
Better Machines—Better Blades

Don't Tool Up for Tomorrow's Boom with Yesterday's Lathes



MONARCH'S HIGH PRODUCTION LATHES OF TOMORROW...



Model 20-H Mona-Matic is available in 18", 30" and 42" center distance. Swing over bed is 15"; over front slide and rear slide ways, 8". Bed ways are flame hardened and ground.

4..The New Model 20-H Mona-Matic—A Low First Cost Production Lathe

Take a good look at what we've done to the Mona-Matic concept of production turning. This new machine

(1) *Carries a low price tag, because of simplified design*

(2) *Has fast hydraulic feed and traverse movements, making it exceedingly productive*

(3) *Is a dependable day after day performer, requiring only routine maintenance for years of trouble-free service*

The Model 20-H is a fully automatic double carriage turning machine, with a 60° "Air-Gage Tracer" controlled front tool slide. A variety of automatic cycling arrangements provides high productiveness and versatility. Eight spindle speeds are available by pick-off gears in each of three standard ranges. The tailstock has an air actuated spindle and inbuilt, heavy duty, anti-friction center.

Front carriage feed rate is infinitely variable from 1" to 40" per minute; traverse is 200" per minute. Rear slide feed rate is ½" to 40" per minute while traverse is at 90" per minute.

Four different feeds are available to the carriage. Either a one or a two cut cycle can be furnished. Two cut cycle machines are provided with a selector switch for one or two cut operation.

Imagine better performance at lower cost these days! Why not let us set up a demonstration on your parts? *The Monarch Machine Tool Company*, Sidney, Ohio.

Monarch
TURNING MACHINES

IF IT CAN BE TURNED, THERE'S A MONARCH TO DO IT BETTER AND FASTER

CIRCLE 205 READER SERVICE CARD

GUSTAV VON REIS, President
Detroit Broach & Machine Co.

a man who came to Fair Street

"We went to Fair Street to find out for ourselves if DeVlieg's fine reputation was backed up by facts"

"We were convinced. We purchased two JIGMILS and they have now been in operation for several years. These machines have all the fundamentals required to produce the highest degree of accuracy, and yet, are simple to operate. Besides this, and we feel most important of all, the JIGMIL has special features which largely eliminate our reliance on the human element to produce close tolerance work. JIGMILS enable us to produce our broaching machines and broaching tools to the very highest degree of accuracy, a matter of the utmost importance in our products."

GUSTAV VON REIS

DE VLIEG MACHINE COMPANY, FAIR STREET • **ROYAL OAK, MICHIGAN**

CIRCLE 206 READER SERVICE CARD

SOME OF OUR JIGMIL USERS

Akramatic Engineering
American Mach. & Tool Co.
Apex Corp.
Barker Tool Die & Gauge Co.
Base Tool & Gage Co.
Bengal Boring Co.
Best Tool & Engineering Co.
B. H. Aircraft Co., Inc.
Black Rock Mfg. Co.
Bradley-Thompson Tool Co.
City Pattern Foundry & Mach. Co.
Compton Boring Co.
Crest Tool Industries, Inc.
Dearborn Tool & Die Co.
Detroit Gauge & Tool Co.
Detroit Jig Grinding Co.
Eglinton Carbide Products, Inc.
Ensign Tool & Gauge Inc.
Evans Tool & Die Co.
Fuller Tool Co.
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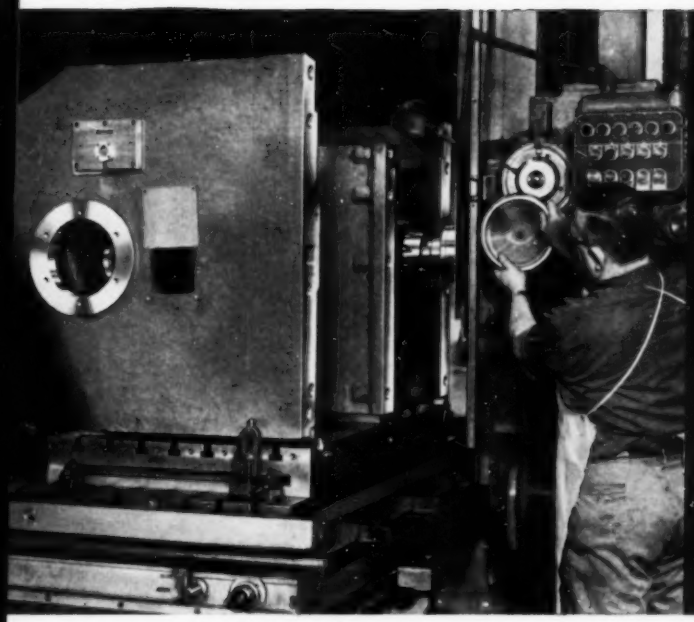
Hiser Jig Grinding Co.
Jameson Machine Co.
Jones Tool Products
Lamina Dies & Tools, Inc.
Langlois Tool & Die Corp.



A FEW PROVEN ADVANTAGES OF THE JIGMIL TECHNIQUE

- Eliminates cost of expensive jigs and production delays resulting from their manufacture.
- Simplifies tooling.
- Employs automatic functions to reduce factors of human error even in close tolerance work.
- Makes possible greater flexibility of product design.
- Improves end product by permitting interchangeable assembly of parts without hand fitting.
- Increases production and product accuracy.

ACCURACY IS AN ECONOMY!

JIGMIL—EXTREME ACCURACY ON LARGE, WEIGHTY PARTS FOR DETROIT BROACH

Broaching machine knee, 65" long, weight 5500 lbs., set-up on a 32" x 60" index table on a Model 4B-72 JIGMIL. The knee is rough and finish milled, bored, drilled and tapped from four sides in one set-up. Formerly machined on a conventional boring mill, the job took 120 hours. The JIGMIL now completes all machining operations in 50 hours with consistent accuracy and without special tooling. Furthermore, the accuracy achieved effects substantial reductions in assembly time and improves the quality of the end product.

Maks Machine Co.
Mark Twain Tool & Mfg. Co.
McDonnell Machine Products, Inc.
Modern Industrial Eng. Co.
Mohawk Metal Forming & Tool Corp.
Mt. Clemens Mfg. Co.
Olofsson Tool & Die Co.
A. E. Parker & Sons Co.
Precision Boring Co.
Product Engineering & Mfg. Corp.
Progressive Industries Co.
Schwartz Mach. Co.
Special Machine & Eng., Inc.
Tragge Boring Co., Inc.
Turner Bros., Inc.
Vulcan Eng. Co.
Westfield Tool & Eng. Co.

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Our newest catalog will help you decide. May we send it?

DeVlieg

SPIRAMATIC JIGMILS®

ACCURATE HOLES AND FLAT SURFACES IN PRECISE LOCATIONS

CIRCLE 207 READER SERVICE CARD

ALBRE

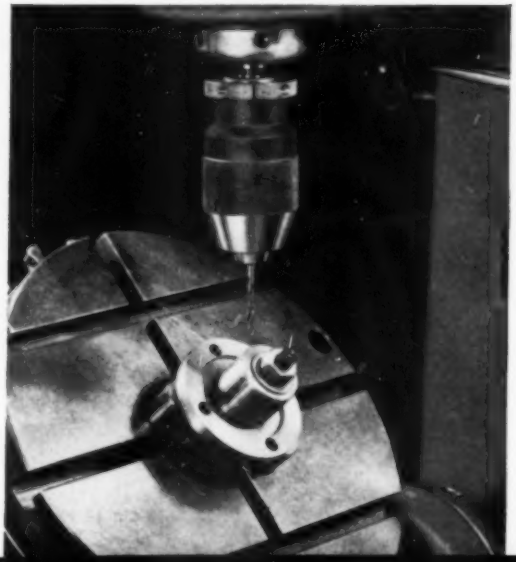
The world's most accurate keyless

On milling machine

The Albrecht Drill Chuck at work in production and in the tool room.

On high speed sensitive drill

Model 15 for small drills (.008" shank)



On jig borer

CIRCLE 208 READER SERVICE CARD

CHT

drill chuck!

Albrecht Heavy Duty Drill Chuck

8 threaded back models—capacities 0-⅝"

12 taper mounted models—capacities 0-⅝"

Now available in threaded back models for portable tools

INDUSTRIAL DISTRIBUTORS · SERVING INDUSTRY ECONOMICALLY · THE RIGHT HAND OF PRODUCTION

A PARTNERSHIP IN PROGRESS

Your industrial supply distributor makes it his business to know your business. He is always available and ready to fill your needs quickly, dependably and economically. When you need chucks, you can depend upon Jacobs and the Jacobs industrial supply distributor who works with you... your partner in progress through service.

Jacobs
CHUCKS

The Jacobs Manufacturing Company
West Hartford 10, Connecticut

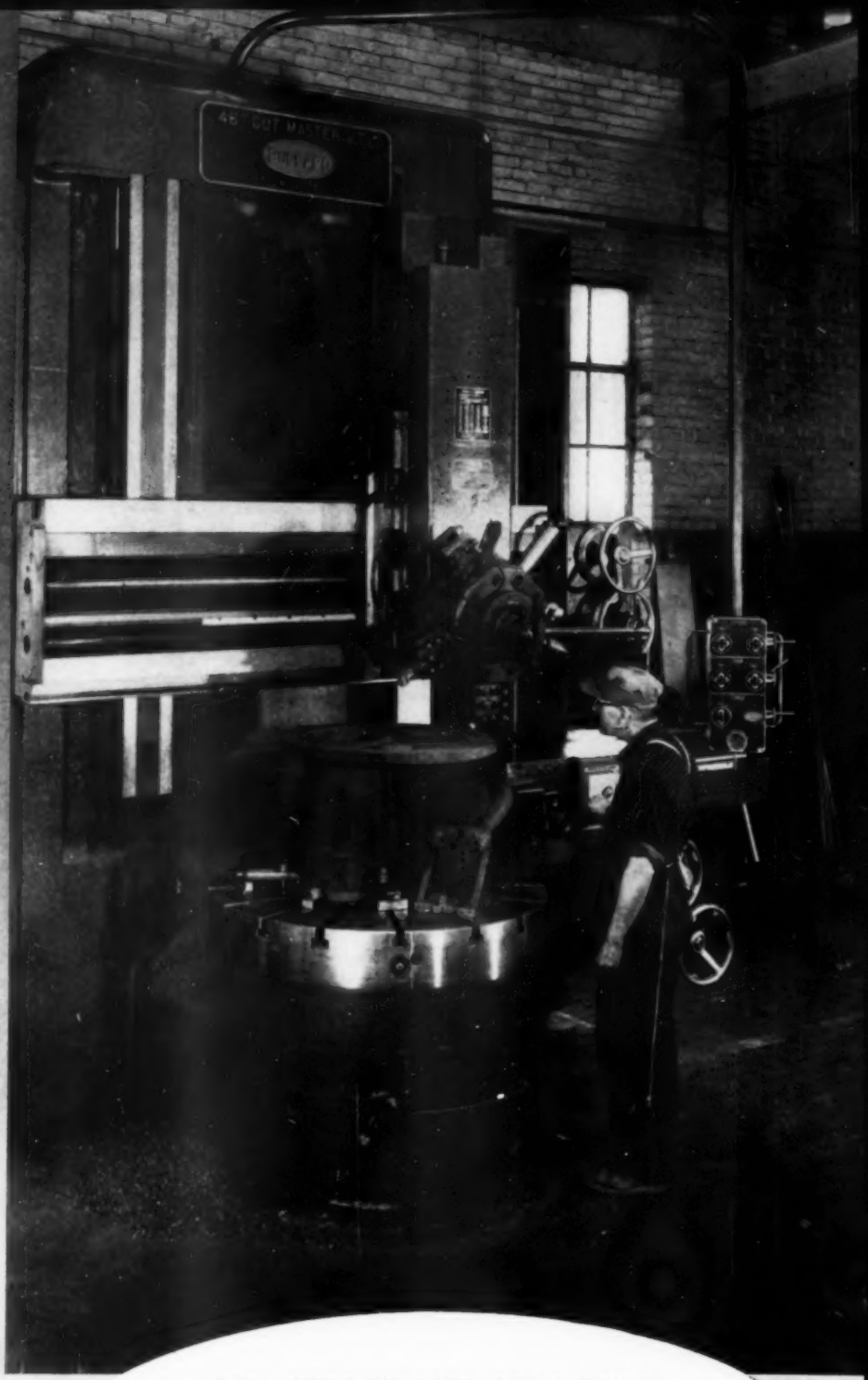
CIRCLE 209 READER SERVICE CARD

"We are WELL SATISFIED with our

BULLARD

Cut Master V.T.L., Model 75

Extreme accuracy is mandatory for a number of machining jobs at the Fuller Company, Manheim, Pa. For example, according to Mr. M. L. Strayer, Machine Shop Supt. "the largest volume piece we process on our Cut Master, Model 75, is the facing of seats for cement diverting valves. They must be perfectly flat. This critical operation is done so accurately on the Bullard Cut Master, Model 75, that with a little hand lapping we have an airtight joint."



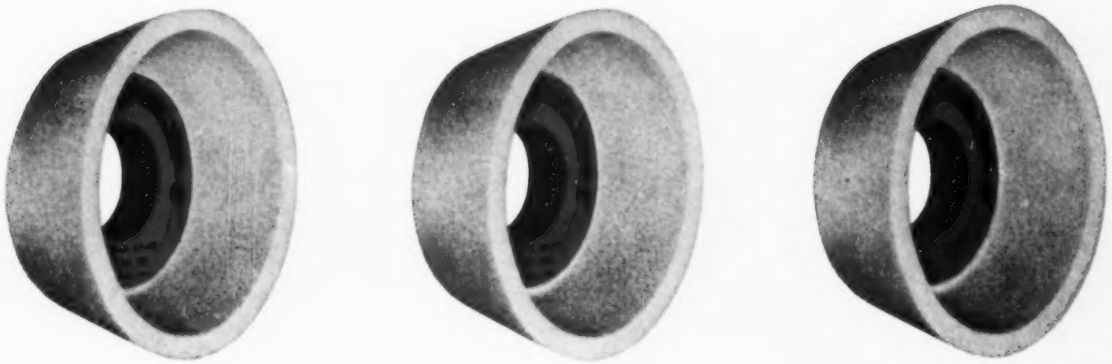
This machine has a 24" extra high bed, speed range 6.8 to 250.0 R.P.M. Equipped with 5 sided Turret Head and 4 sided Side Head, both hand indexing, 4 jaw hand operated chuck.

This "built-in" accuracy, which is inherent in every Bullard Cut Master V.T.L., Model 75, can be applied to your work.

CALL YOUR BULLARD SALES OFFICE
OR DISTRIBUTOR FOR THE COMPLETE STORY

THE BULLARD COMPANY
BRIDGEPORT 9,
CONNECTICUT

POSITIVE DUPLICATION – EVERY TIME!



Each of these gyroscopes positively duplicates the built-in balancing action of every other gyroscope.

And *balance built-in* is an important advantage you get with the toolroom cup wheels shown above, and with *all* CINCINNATI (PD)° GRINDING WHEELS. They are manufactured by a remarkable process that gives Positive Duplication, time after time after time.

With every step of manufacturing rigidly controlled, this unique (PD) process produces wheels of unsurpassed uniformity. One important result: balanced action for a safer job . . . a better job.

When you reorder a CINCINNATI (PD) WHEEL, it will act and grind exactly like the original, helping you maintain production, saving time and money. Whatever shape, grade and size

you specify . . . centertype, centerless, internal, surface, toolroom or snagging wheel . . . you get Positive Duplication — every time!

Our factory representatives are trained specialists, experienced in grinding job set-ups and operations. For their help on those extra-tough grinding problems, call your CINCINNATI (PD) GRINDING WHEEL distributor, or contact Cincinnati Milling Products Division, Cincinnati 9, Ohio.

(PD) POSITIVE DUPLICATION

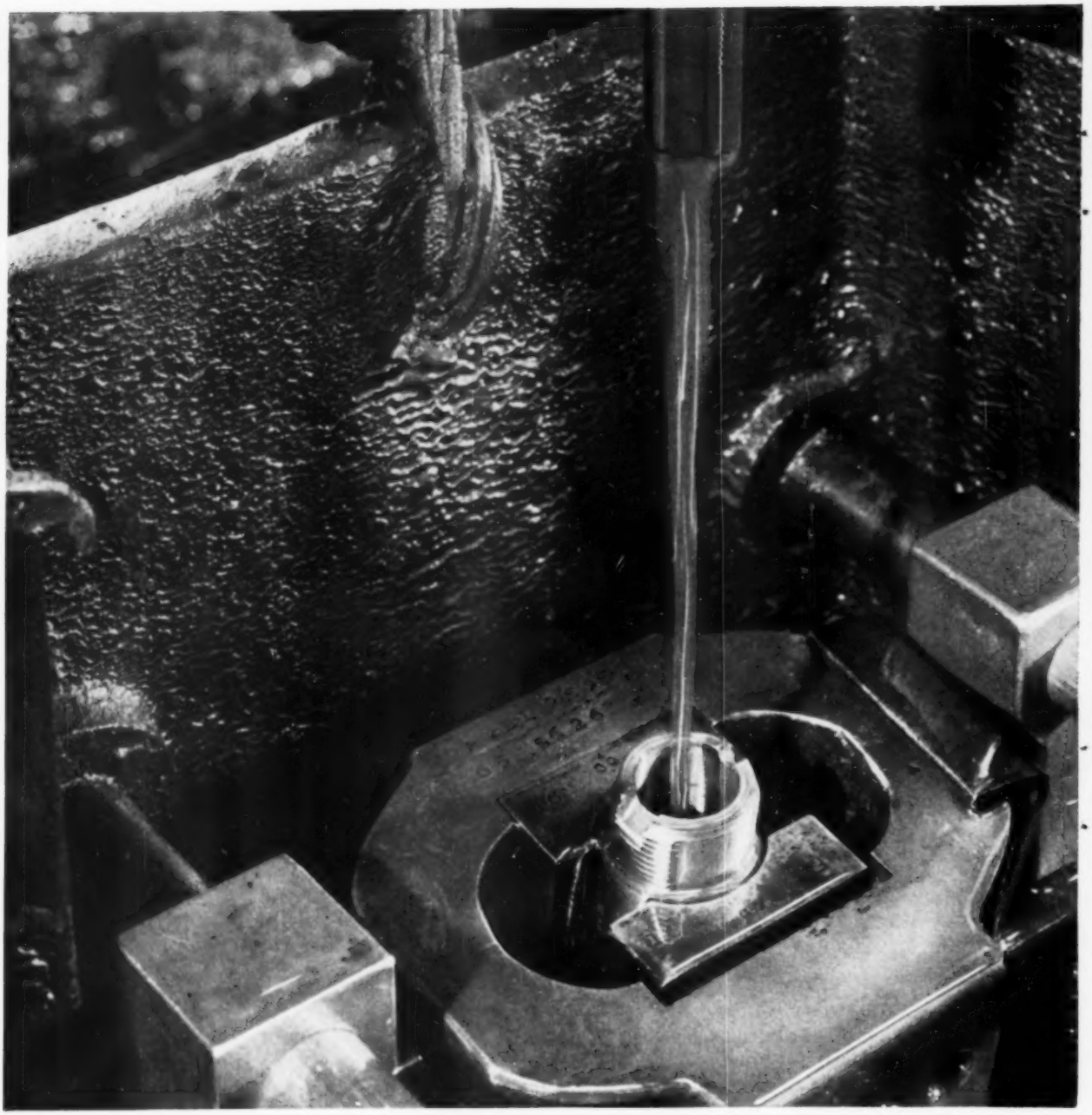
CINCINNATI°

GRINDING WHEELS

A PRODUCTION PROVED PRODUCT OF THE CINCINNATI MILLING MACHINE CO.

CIRCLE 210 READER SERVICE CARD

CIRCLE 211 READER SERVICE CARD



Gulfcut 11A chosen for precision work and fine finishes at

GULF MAKES THINGS

Ithaca Gun Company, Inc., of Ithaca, N. Y., makes the famous Model 37 Featherlight Repeater, Model 37 Rib Grade Repeater and Model 37R DeLuxe Repeater . . . all shotguns to warm the heart of any hunter.

Special steel barrels for these guns are reamed on a 12-spindle machine designed and built by Ithaca Gun engineers. Each gun barrel passes through three borings of different sizes before the proper size choke is achieved. Chokes from .410 gauge to 10 gauge are obtained on this machine, which can bore 80 barrels per hour.

Says A. G. Stevens, Plant Superintendent: "Our gun barrels are reamed to very close tolerances, and they must have a silk-smooth finish. When you're doing precision work like this, cutting oils play a mighty impor-

Shotgun barrel boring machine, designed and built by Ithaca Gun engineers, has 12 spindles on each side. Machine can bore 80 barrels per hour with both sides running.

A. G. Stevens, Plant Superintendent, inspects a Model 37 Featherlight Repeater. Gulfcut cutting oil helps Ithaca Gun maintain the close tolerances essential for accurate-firearms.

Gun barrel is pushed up onto stationary reamer of special boring machine. Gulfcut 11A pours continuously over the boring area and is re-circulated through a filter system.

Ithaca Gun Company . . .

RUN BETTER!

tant part. We've experimented with many different oils, but for our purposes Gulfcut 11A is the best of all."

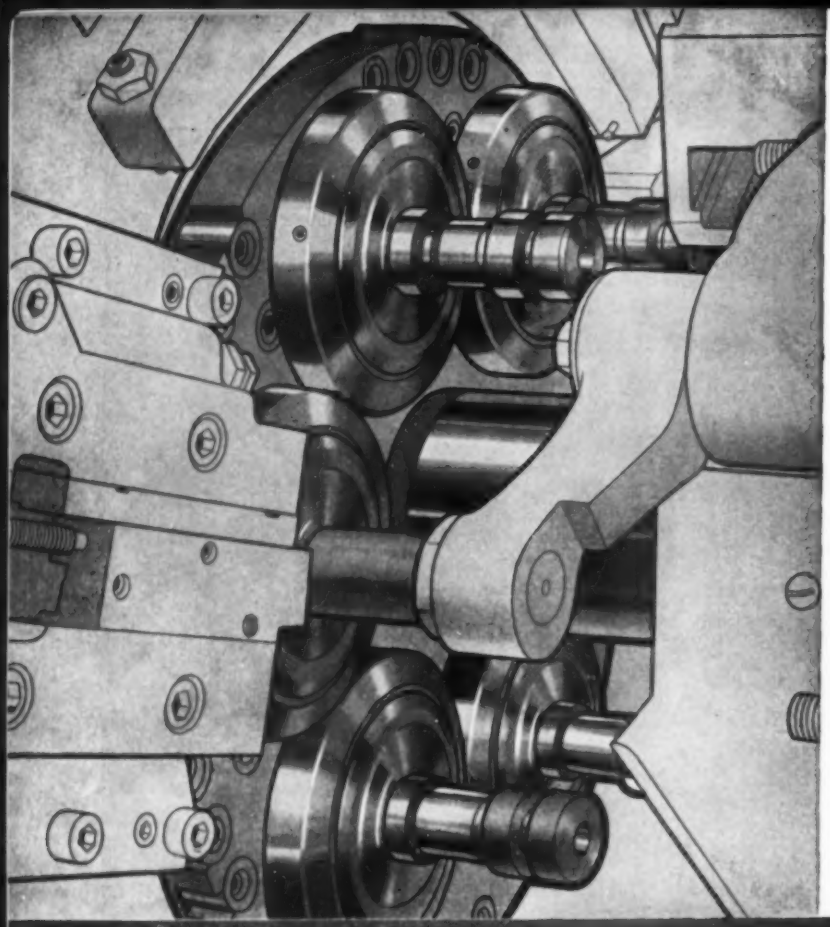
See how Gulf makes things run better in *your* operation. Whatever type of machining you do, you'll find exactly the right cutting oil in the complete Gulfcut line. Send now for illustrated Gulfcut bulletins, or contact your nearest Gulf office.

GULF

GULF OIL CORPORATION
Dept. DM, Gulf Bldg., Pittsburgh 30, Pa.
Send me more information on:
☐ Gulfcut "Regular" Cutting Oils
☐ Gulfcut Heavy Duty Soluble Oils

Name _____
Company _____
Address _____
City _____ Zone _____ State _____

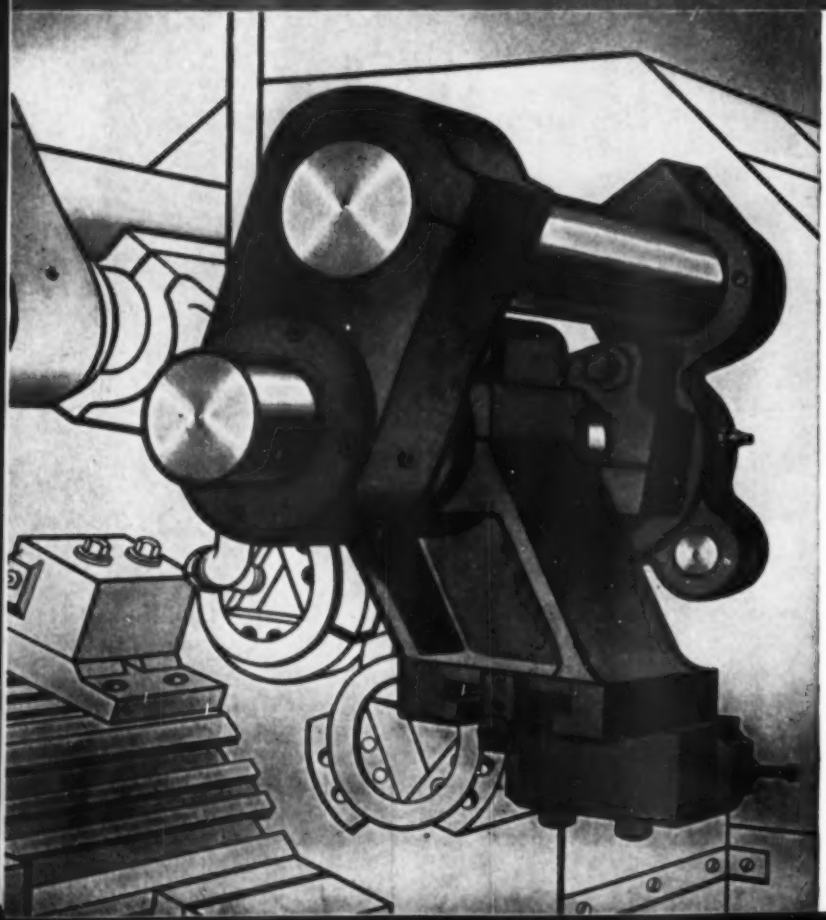
AM-0129



Look at New Britain's

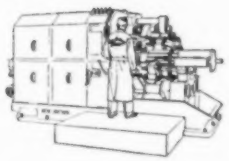
new automatic bar machines

The widest range of spindle speeds among machines of comparable capacity and accuracy.



Look at New Britain's

exclusive chucker arms



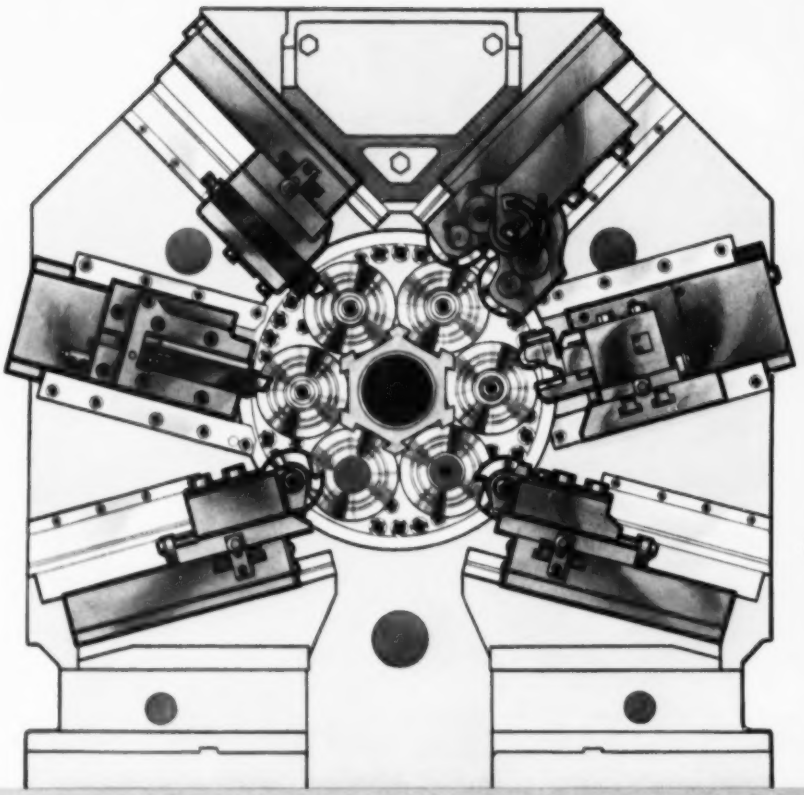
All the ruggedness of a cross slide, but with two-way motion for cutting O.D.'s, I.D.'s, tapers and radii and for recess boring, in addition to facing cuts. New Britain-Gridley Machine Division, The New Britain Machine Company, New Britain, Connecticut.

CIRCLE 214 READER SERVICE CARD

Look at New Britain's

new cross slide arrangement

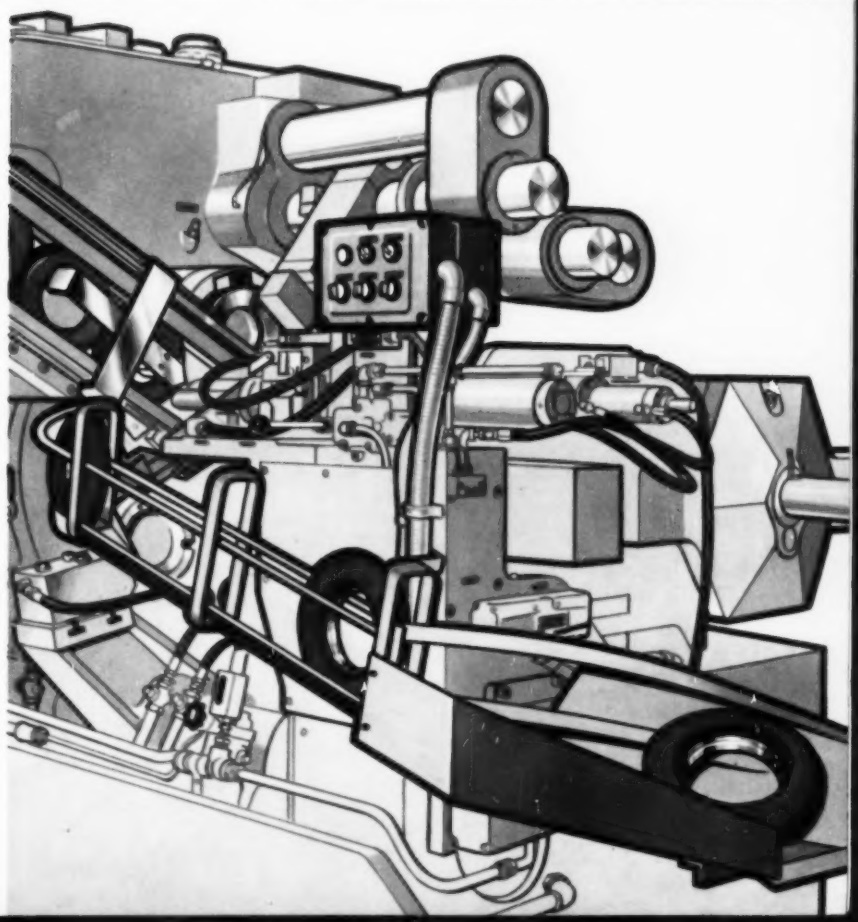
Independent radial cross slides in *all* positions, providing maximum clearance for more cross slide operations.

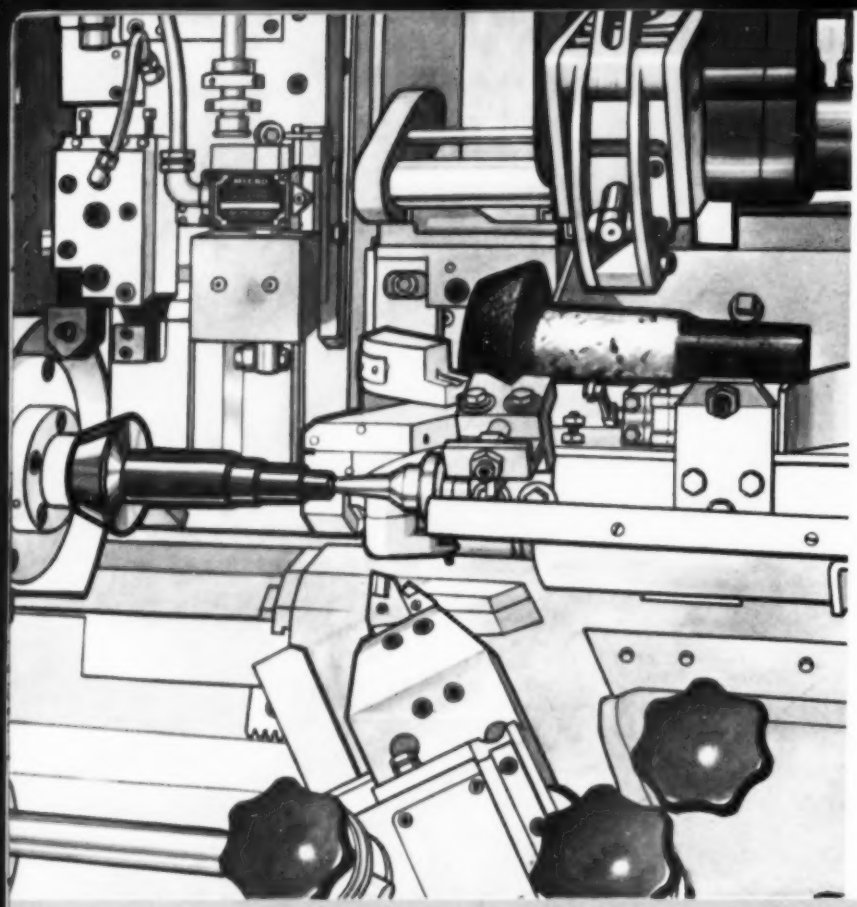


Look at New Britain's

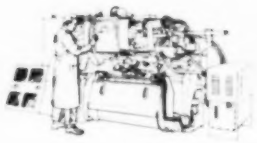
open-end chucker design

Greater accessibility for all applications and particularly well adapted to automatic handling of pieces. New Britain-Gridley Machine Division, The New Britain Machine Company, New Britain, Connecticut.

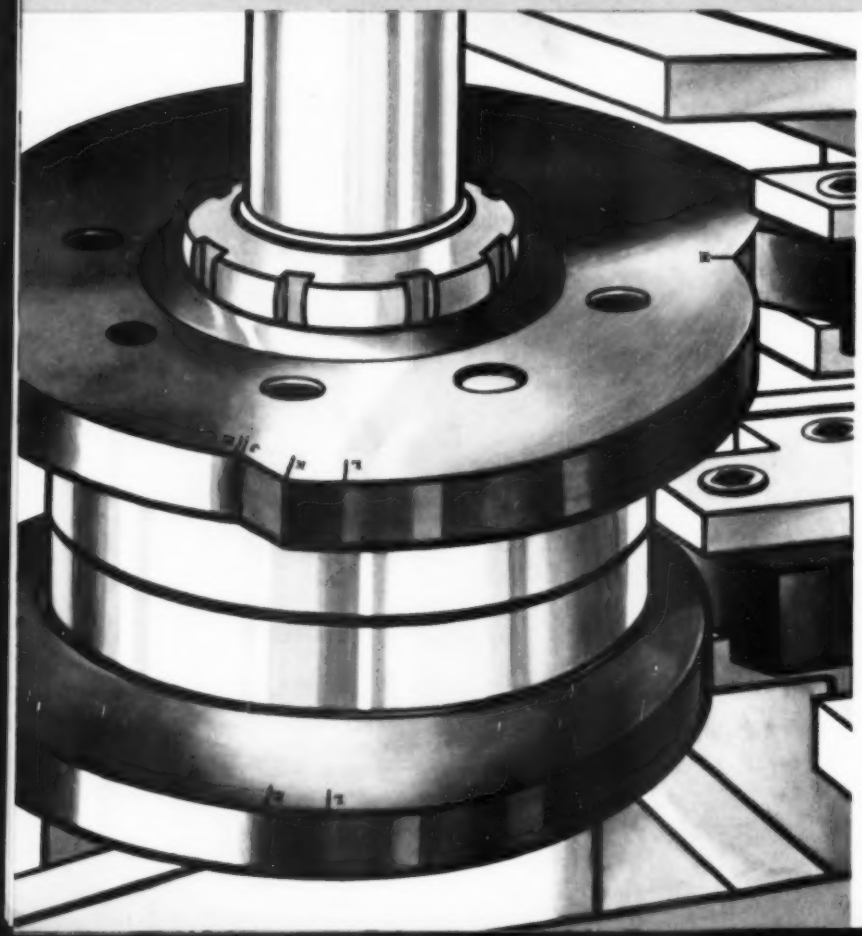




Look at
Automatic Loading on
New Britain +GF+



This basic optional feature can make money for you whether you are working with forgings, bar slugs, or bar stock.

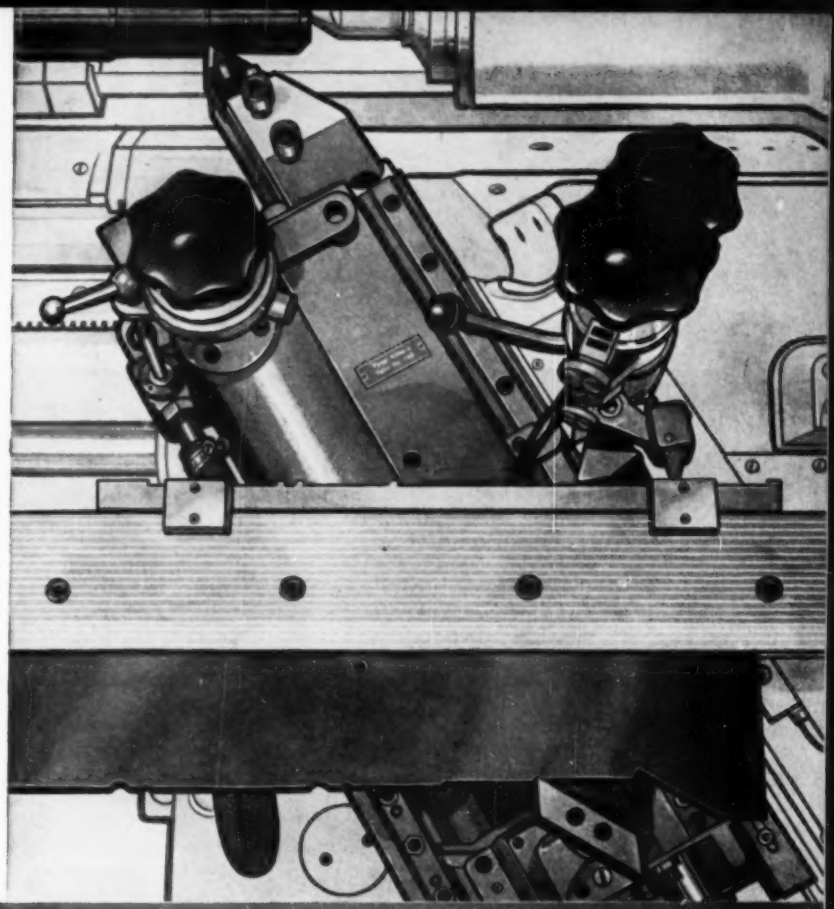


Look at New Britain's
cam-controlled boring machine

When you are working to tenths there is no substitute for the positive tool control that only precision cams provide. New Britain-Gridley Machine Division, The New Britain Machine Company, New Britain, Connecticut.

Look at
Single Point Tooling on
New Britain +GF+

Outproduces gang tooling setups by reducing tool change time practically to zero, and by cutting at maximum speeds and feeds for tool efficiency.

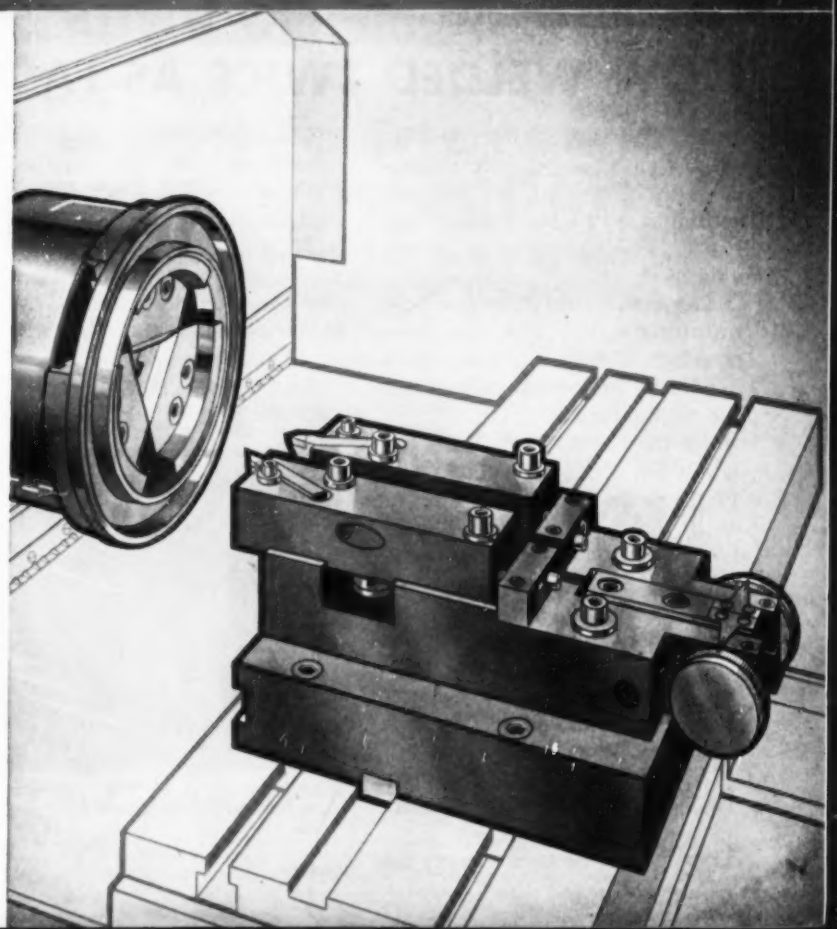


Look at New Britain's
simple approach to problem pieces

Low cost per piece is inherent in New Britain Precision Boring Machines because of their simplicity, versatility, speed, repetitive accuracy and inexpensive tooling. New Britain-Gridley Machine Division, The New Britain Machine Company, New Britain, Connecticut.

CIRCLE 217 READER SERVICE CARD

◄ CIRCLE 216 READER SERVICE CARD



Lincoln

WELDYNAMICS

NEWS ABOUT ARC WELDING AT WORK CUTTING COSTS

Oil well pump chain housing is positioned for flat welding with Jetweld. Welding speed is doubled.

OIL FIELD PUMPING UNITS NOW WELDED TWICE AS FAST

Doubling welding shop production without increasing their investment in labor or machines was accomplished by the Parkersburg Rig and Reel Company at Coffeyville, Kansas.

This firm manufactures oil field pumping units. The complete structure of these units is welded and varies in size depending upon the requirements of the well on which they are to work. Bases are fabricated from as small as 8" 17 lb. beams to as large as 14" 68 lb. beams. One exceptionally large unit used a 36" 210 lb. member for the walking beam.

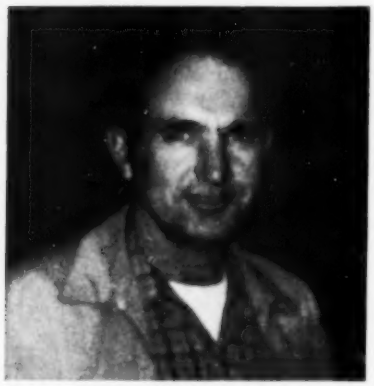
Under the supervision of Jess Kern, Plant Manager and Sammy Doss, Welding Foreman, tests were conducted in the Parkersburg shop in an effort to increase welding efficiency.

A Lincoln welding engineer, Robert Clipsham, surveyed the welding operation. He studied the procedures used and conducted tests with various electrodes and equipment.

The survey indicated that with minor positioning changes almost every weld could be made with a faster, easier-operating iron-powder electrode.

Parkersburg is now using Jetweld 1 electrodes almost exclusively. Mr. Doss says, "Jetweld is twice as fast as the conventional electrodes we were using. It gives us better looking welds, mileage per rod is greater, and weld cleaning is much easier and faster."

Completed chain housing mounted on base fabricated from I beams.



Sammy Doss, Welding Foreman at Parkersburg Rig and Reel has switched to Jetweld almost exclusively.

For help with welding procedures and cost reduction ideas call your Lincoln welding engineer today.

NEW WELDER TAILORED TO YOUR NEEDS

The new Lincoln Idealarc "TM" welder has been designed to meet the needs of any shop.

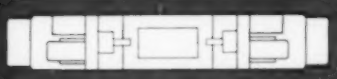
The key to the "TM" model's versatility is a wide range of options that expand the uses for the machine.

These new Idealarcs are available in 300, 400, 500 and 650 amp sizes.

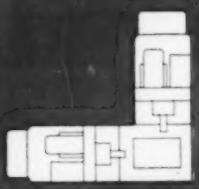
Bulletin 4607.1 has all the details. A copy may be obtained by writing The Lincoln Electric Company.

The LINCOLN ELECTRIC CO.
Dept. 2032 • Cleveland 17, Ohio
The World's Largest Manufacturer of Arc Welding Equipment

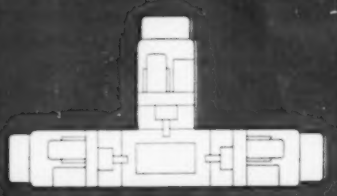
ONE WAY



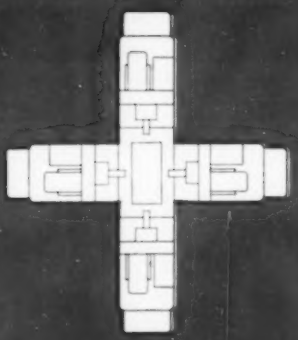
TWO WAYS AT 180°



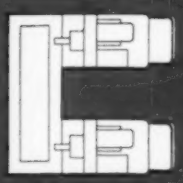
TWO WAYS AT 90°



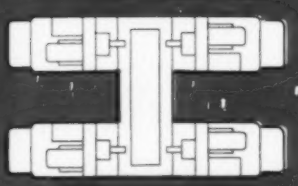
THREE WAYS



FOUR WAYS



MULTI-WAYS



MULTI-WAYS

Ex-Cell-O 4-Way Machine precision bores four holes simultaneously, holding 90° angles.

7 ways to increase your production

Three new features on all Ex-Cell-O Way Machines give even greater production and precision

The diagrams at left tell a story.

Ex-Cell-O Way Machines using standard components in the combinations illustrated perform precision boring, turning, facing, grooving and chamfering operations economically and quickly. They take large work pieces in stride—the spindles move to the work.

In each machine three new features assure long life, dependable operation, and exceptional accuracy.

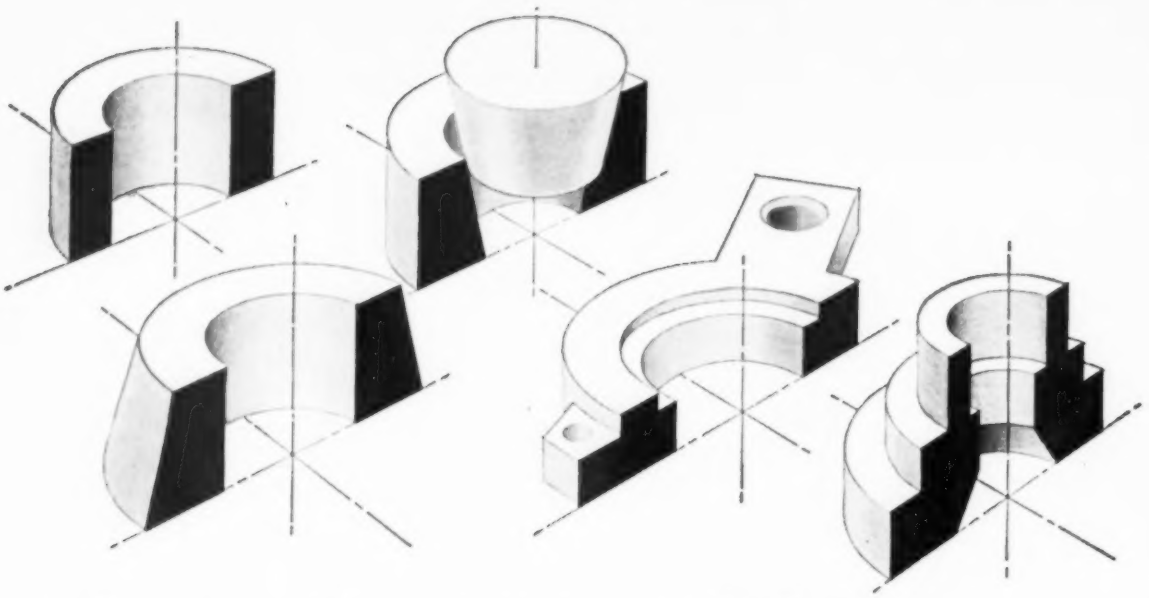
The features: (1) ways are hardened and ground, (2) slides are fully supported the length of the stroke, (3) hydraulic control panels give a wide range of automatic cycles.

Write Ex-Cell-O in Detroit for further information. Better still, call in an Ex-Cell-O representative.

EX-CELL-O CORPORATION
DETROIT 32, MICHIGAN
Machinery Division

DETROIT 32, MICHIGAN • Ex-Cell-O Precision Products Include: Machine Tools • Grinding and Boring Spindles • Cutting Tools • Railroad Pins and Bushings • Drill Jig Bushings • Torque Actuators • Thread and Groove Gages • Granite Surface Plates • Aircraft and Miscellaneous Production Parts • Dairy Equipment

56-44R



when to consider Vertical Grinding

A simple test you can try for yourself quickly determines whether you should consider the Springfield principle of *vertical* grinding. Try it!

CHECK YOUR ANSWERS TO THIS QUIZ	YES	NO
1. Do you grind holes 4" in diameter and larger?	☐	☐
2. Do you grind taper holes or mating parts?	☐	☐
3. Do you grind on irregular shaped work?	☐	☐
4. Do you grind O.D. or I.D. shoulders, offsets, undercuts?	☐	☐
5. Do you grind pieces requiring extreme concentricity?	☐	☐
6. Do you require a 5 micro-inch or better finish?	☐	☐
7. Do some of your grinding jobs require many setups?	☐	☐

If you answer yes to three or more questions, a Springfield vertical universal grinder probably can save real time and money in your plant. Mail the coupon today for your free and informative copy of "Vertical Universal Grinders"; Bulletin 197-F.

THE SPRINGFIELD MACHINE TOOL CO., SPRINGFIELD, OHIO

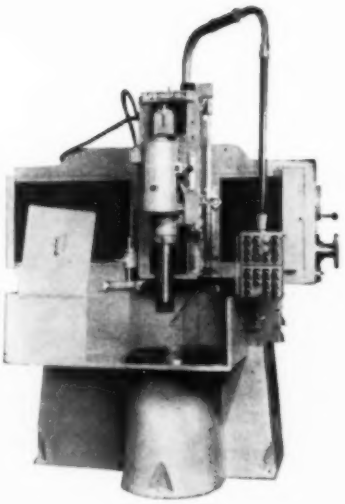
SPRINGFIELD

name & title _____

company _____

address _____

city, zone, state _____

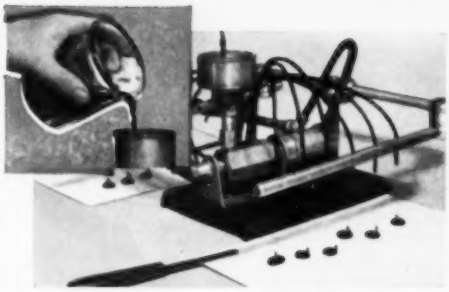


Above is a standard Springfield 2A-TR vertical universal grinder. It swings 25"; the grinding head has a 21" stroke and it grinds holes to a nominal depth of 18". The head can be tilted 45° in either direction. Electro-hydraulic control is standard with pendant pushbuttons. The Model 2A-TR costs less than most horizontal chucking grinders of comparable size; it can do the same work plus a wide variety of jobs that just can't be done on a horizontal. Gravity works for you in vertical grinding.

Bertsch & Co. finds solution to lubrication problem...with Standard Oil's

RYKON Grease R

Centralized lube system pumps grease through 80 ft. lines in cold temperature; no clogging



Lab demonstration shows how RYKON Grease R works. Grease is poured into reservoir as a fluid. The shearing action exerted by pump and outlets irreversably converts fluid to a grease. Grease is ejected from outlet lines.

Problem: Bertsch & Company, Cambridge City, Indiana, makes pinch rolls and other metal bending equipment. A centralized lubrication system used on one pinch roll model had to pump grease 80 feet. Greases tried could not be pumped this distance without clogging lines. Since machines are shipped all over the world and are often in operation in cold climates, Bertsch had additional problems. The grease had to be pumpable in cold temperatures. It had to be foolproof so that customers beyond the reach of service calls would experience no problems.

What was done: Bertsch turned to Standard Oil for help. Standard Oil man, D. M. Simmons had the answer: RYKON Grease R. This is a rheopectic grease, one that flows like an oil. Its rheopectic properties cause it, under slight shearing stresses, to turn to a thick, durable grease. RYKON Grease R flows to the pump as a fluid, lubricates the bearings as a grease.

What you can do: Maybe you manufacture equipment that needs a centralized lubrication system and you have been looking for a grease like RYKON R. Get the facts about RYKON Grease R from your nearby Standard Oil lubrication specialist anywhere in the 15 Midwest and Rocky Mountain states. Or write **Standard Oil Company (Indiana), 910 South Michigan Ave., Chicago 80, Illinois.**

You expect more from **STANDARD** *and you get it!*

Sons of founder, Harry E. and Robert O. Bertsch talk with Standard Oil lubrication specialist Donald M. Simmons. Don is well qualified to work with customers on difficult lubrication problems. He has the training and experience for it. Don graduated from Purdue. He has seven years service with Standard. He has completed the Standard Oil Sales Engineering School.

Howard Beacham tripled wheel life,

Howard Beacham has been a Bay State Abrasive Engineer for fifteen years and his total experience is double that. He's worked on grinding problems that have involved every type of metal in jobs as tiny as miniature bearings and as big as the world's largest air compressors and steam turbines.

cut dressing frequency in half at New Process Gear

The closer you get to automation, the more it hurts to have production interrupted. That was the principal problem at Chrysler's New Process Gear Division where semi-automatic grinding of flats on truck transmission shafts was halted by wheel dressings every eleven pieces.

The three competitive wheels used in this simultaneous "cam grinding" operation wore down so fast they had to be replaced every week. And, on top of that, an alarming number of shafts were being cracked during the grinding operation.

Bay State's Howard Beacham was called in on the job. He specified a trio of Bay State wheels that produced really spectacular results.

Production jumped to twenty-five perfect shafts per dressing and wheel life went up to three full weeks. Finish was excellent, too.

Why not talk to your own Bay State representative next time you have a grinding problem? Like Howard Beacham he's a trained specialist. *Better grinding at lower cost . . . that is his business.*

Operator Henry Kotas runs grinder equipped with one 24 x 1-21/32 x 12 and two 24 x 1-3/4 x 12 Bay State wheels. The three wheels simultaneously grind flats on main shaft for 5-speed truck transmission.

(*Above*) Manufacturing Engineer Wiley Bell and Plant Superintendent Nelson Fisk examine finished truck transmission shaft.

BAY STATE WHEELS of PROGRESS

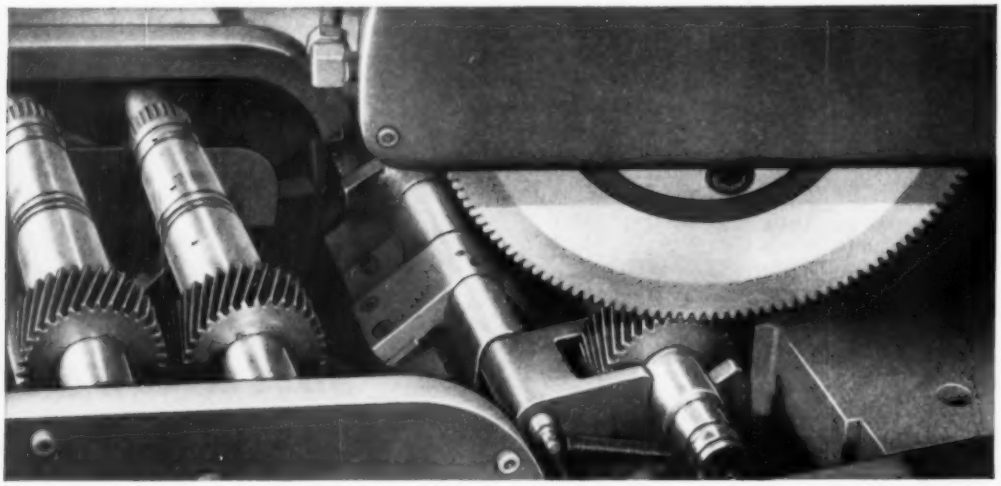
BAY STATE ABRASIVES

Bay State Abrasive Products Co., Westboro, Massachusetts.
In Canada: Bay State Abrasive Products Co., (Canada) Ltd., Brantford, Ontario.
Branch Offices: Bristol, Conn., Chicago, Cleveland, Detroit, Pittsburgh. *Distributors:* All principal cities.

Hard Gear Tooth Honing has completed the transition from an engineering research project to its present operational status in less time than any other major development in the field of modern gear practice. Why? Because Hard Gear Honing satisfies a long recognized need more economically than any other known process.

RED RING HARD GEAR HONING

Has Won Wide Acceptance



USERS

- The aircraft industry
- The automotive industry
- Computing machine manufacturers
- Motorcycle industry
- Tractor industry
- Gear manufacturers
- Electric motor (gear head) industry
- Machine tool builders

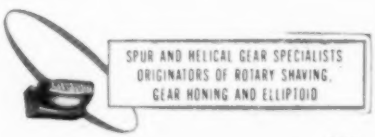
GEARS BEING HONED

- Transmission gears
- Timing gears
- Change gears
- Computor gears
- Main drive gears
- Motorcycle gears

PURPOSE OF HONING

- To remove nicks and burrs
- To improve surface finish
- To improve noisy gears
- To salvage rejects
- To quickly detect errors in prior machining
- To correct minor heat treat distortions

For complete details on Hard Gear Honing, write for Bulletin H-57-2.



8269

NATIONAL BROACH & MACHINE CO.

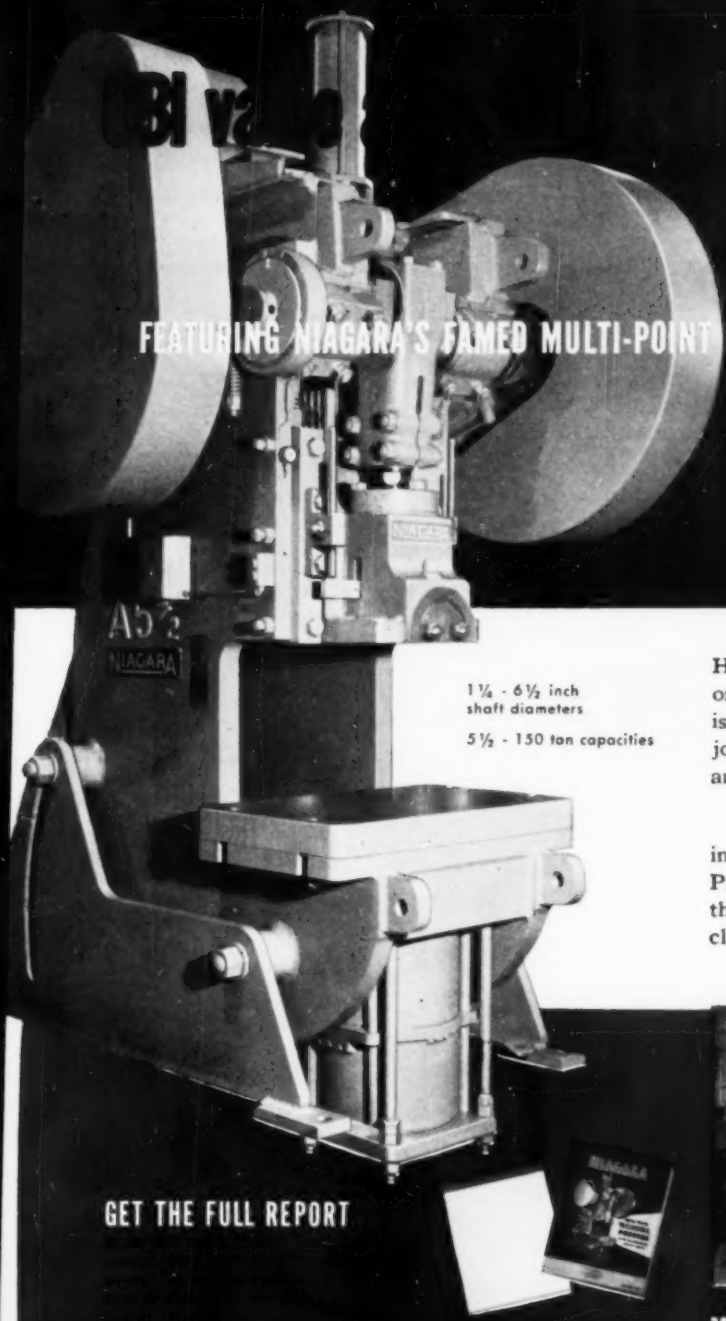
5600 ST. JEAN • DETROIT 13, MICHIGAN

WORLD'S LARGEST PRODUCER OF GEAR SHAVING EQUIPMENT

TON FOR TON . . . DOLLAR FOR DOLLAR

FEATURING NIAGARA'S FAMED MULTI-POINT MECHANICAL SLEEVE CLUTCH

Picks up load on 14 engaging jaws. Applies driving force concentrically without keys or pins. Assures instant engagement and maximum productive strokes per minute. Needs no air nor electricity. Practically no maintenance. Greater safety: Simplified controls, fewer parts to wear out. *Yes, it permits, inching, too.*



1¼ - 6½ inch shaft diameters

5½ - 150 ton capacities

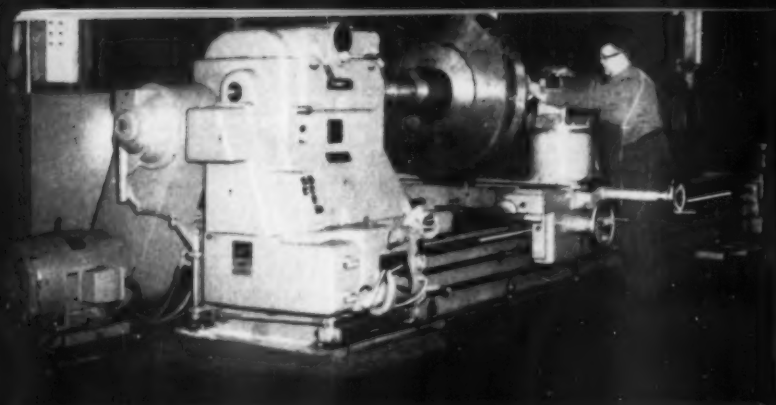
Here's a workhorse that's known for setting the pace on the most demanding jobs... jobs where the clutch is engaged and disengaged at every press stroke... jobs that call for operation three shifts a day, day in and day out.

Built and *backed* by a company which produces industry's greatest variety of inclinables*, Series A Presses have amassed an unusual success record in thousands of applications. To be specific, let's take a close look at a Series A user:

28 OBI'S SINGLE STROKED 707,140,000 TIMES WITHOUT ONE CENT SPENT ON CLUTCH ENGAGING SURFACES

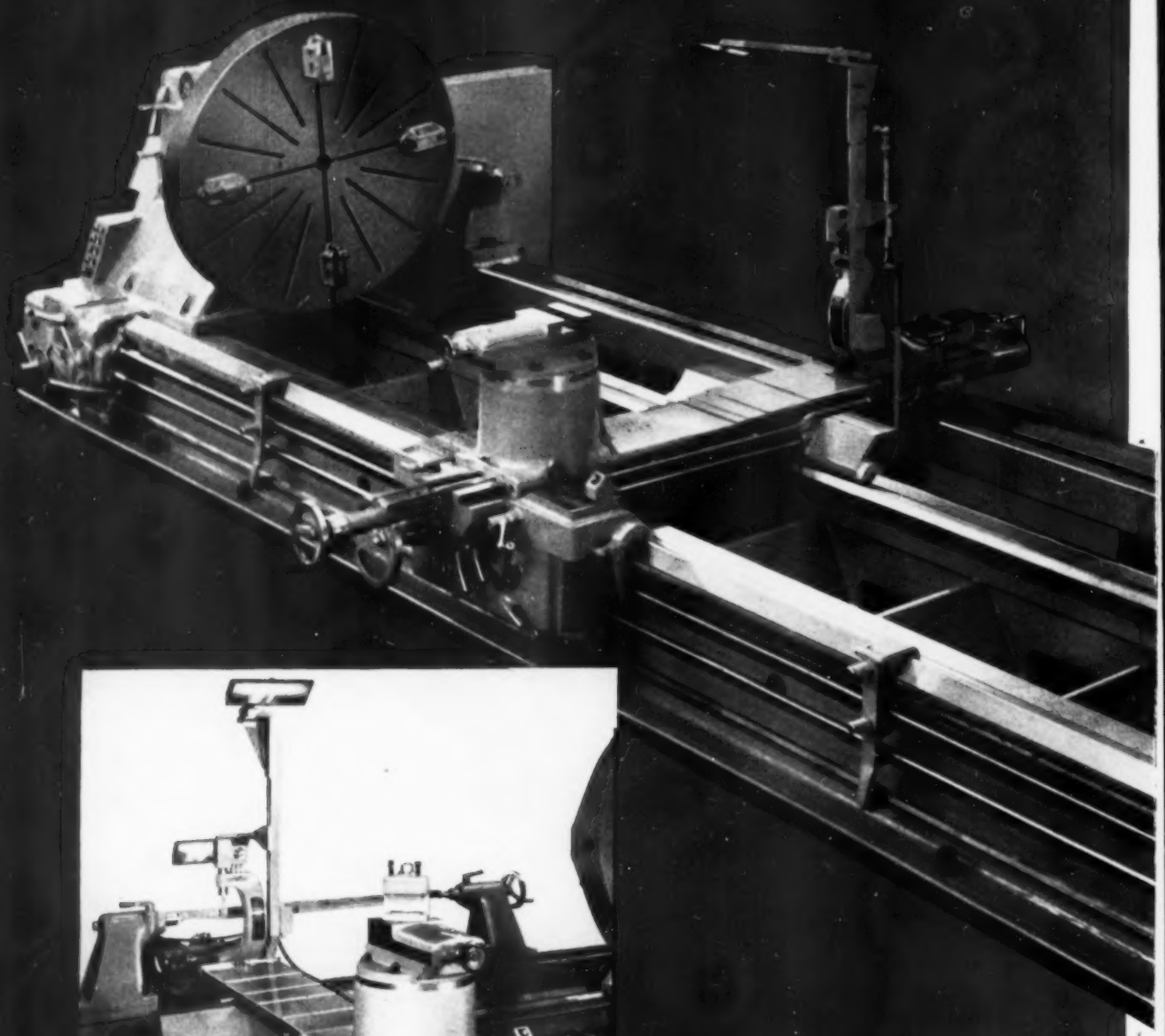
GET THE FULL REPORT

NIAGARA

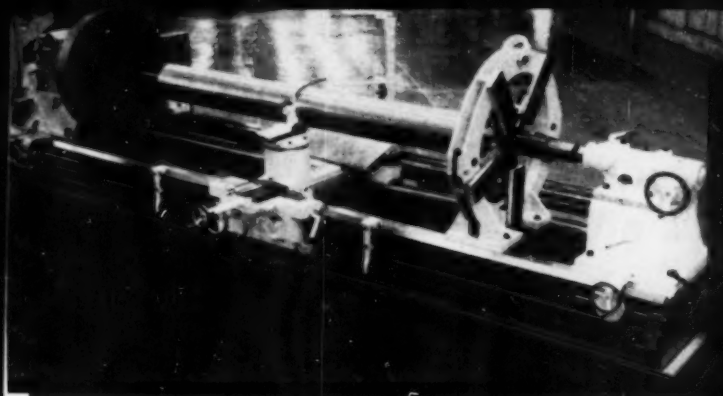


A large missile component being tracer-machined at a major West Coast missile plant on a Space-Master with 60" swing and 21' centers.

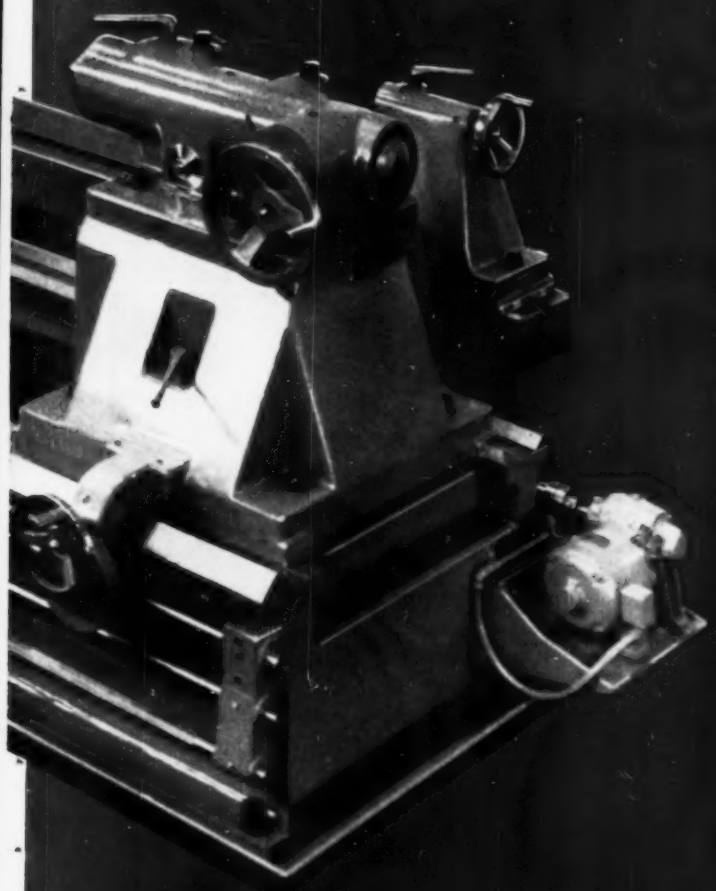
This Sidney Space-Master is contouring steel rolls up to 50" diameter to close tolerances.



Close-up of the Sidney Fluid Tracer with periscope mirrors which permit watching the tracer while machining large work.



for high precision
on large parts



Introducing the SIDNEY SPACE MASTER©

With swings up to 72 inches and center distances up to 51 feet, the Sidney SPACE-MASTER© is the answer for those manufacturers looking for precision on large MISSILE AND ROCKET PARTS.

Available with or without the Sidney Fluid Tracer, the Space-Master is full of precision-insuring and time-saving features. Here are some of them:

- **Lapped herringbone gear headstock**
- **60 thread and feed changes**
- **Powerful rapid traverse**
- **Double-walled apron**
- **Massively bridged bed**
- **Large support areas throughout for carriage, slide, tailstock, etc.**
- **Heat-treated lathe rack**
- **Graduated dial to measure tailstock spindle travel**
- **Honed tailstock bore**
- **Anti-friction bearings**
- **Periscope mirrors for Tracer when machining large parts**

If you want to speed output, hold your tolerances down (to ± .001) and cut your cost, it will pay you to look into the Sidney Space-Master. Ask for Bulletin #S-600.

SIDNEY MACHINE TOOL CO.
SIDNEY, OHIO
Wholly owned subsidiary of Buhr Machine Tool Co.

"Carlton's a valuable production tool in jet engine drilling"

Robert L. Clark, Works Manager, Ryan Aeronautical Co., San Diego, has supervised the production of hundreds of Ryan jet engine structures like the sensational Vertijet shown above. He says:

"Carlton is the kind of radial drill you can count on for production hole drilling like the jet engine H-ring (below)."

It will pay you to investigate Carlton radial drills for *all* your drilling and boring requirements. Unlimited choice of arm and column sizes and the most modern programming-preselect speed-feed control systems. Write for descriptive bulletins. The Carlton Machine Tool Co., Cincinnati 25, Ohio.

Carlton 3A Radial drills and reams 200 holes in the H-flange of this Ryan jet engine component.

Carlton ... *specialists in Radial Drills*

CIRCLE 228 READER SERVICE CARD

Now...

from your Heller distributor...

the IMPROVED AISI-01

flat ground die steel

Heller

Combining the MOST WANTED ANALYSIS

...with the MOST NEEDED FEATURES!

CALL YOUR LOCAL DISTRIBUTOR and

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SERVICE + STOCKS = SAVINGS

1. **EASY MACHINABILITY!** The special spherodized annealing of Heller's Die Steel assures you of the finest grain structure, the easiest machinability, and the most uniform hardening.

2. **SMOOTHER FINISH!** Surface finished to 25-35 micro inches, with all decarburization and surface defects removed, the new Heller "01" is ready for scribing, shaping and heat treating on arrival.

3. **COST CUTTING CONVENIENCE!** The wide range of standard stock sizes locally available allow you to avoid the hidden costs of machining, grinding and cutting to size. No interruption of your regular work load, all you do is call your Heller distributor.

4. **BETTER PACKAGING!** All sizes of this improved "01" are individually wrapped in protective packages. Dimensions you can trust and heat-treating directions anybody can follow are printed on every package!

YOU CAN EASILY SELL NEW HELLER "01" by telling big users of flat ground die steel that you can supply the analysis they prefer with these outstanding features. Once they try it, they'll always buy it!

HELLER TOOL CO.

HELLER TOOL CO. SINCE 1836

America's Oldest File Manufacturer
NEWCOMERSTOWN, OHIO
Subsidiary of Simonds Saw and Steel Co.

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1ST The outstanding Type RCP Constant Potential Power Source for gas shielded fully automatic and semi-automatic welding. Available in 500, 600 and 1000 amp ratings to suit every need. May be used with separate Dynamic Reactor.

2ND A complete 200 amp. Type RCC Constant Current Welding Power Source "package" for use with the popular WESTINGARC® SA-110 and SA-111 semi-automatic hand guns and control monitor. Converts to manual welding use at the flick of a switch.

NOW!

ANOTHER ADVANCEMENT TO EXTEND YOUR WELDING VERSATILITY

Westinghouse

"RCV" Welding Power Source

WITH BUILT-IN DYNAMIC REACTOR

It's the NEW 200-amp, Type RCV Constant Potential Power Source for gas-shielded welding—specifically designed as the most important "companion" for the WEST-ING-ARC SA-120 and 121 hand gun and control monitor.

The RCV Power Source, with its built-in contactor and controls and built-in Dynamic Reactor, opens new fields for welding of light-gauge steels—mild and stainless—aluminum and magnesium. It permits all-position welding . . . reduced welding wire costs . . . improved "wash" and penetration over a broad range of applications and material thicknesses.

Contact your nearest Westinghouse welding distributor or welding sales engineer. Or write: Welding Division, Westinghouse Electric Corporation, Buffalo 5, New York. J-22001

Features:

• Primary circuit breaker with full over-current protection • Thermoguards® in each transformer winding for thermal protection • Single phase—230 volts. May be used where higher primary voltage is not available; reconnectable for 460 volts • Auxiliary transformer for 110 volts to supply control monitor • Built-in contactor—operated by trigger of SA-120 and 121 gun
• Built-in Dynamic Reactor • Bonderized finish
• Dead-front Cam-Lok cable terminals and plug connection
And many other user advantages!

$795 IN ZONE 1
Zones 2 and 3 slightly higher

YOU CAN BE SURE...IF IT'S Westinghouse

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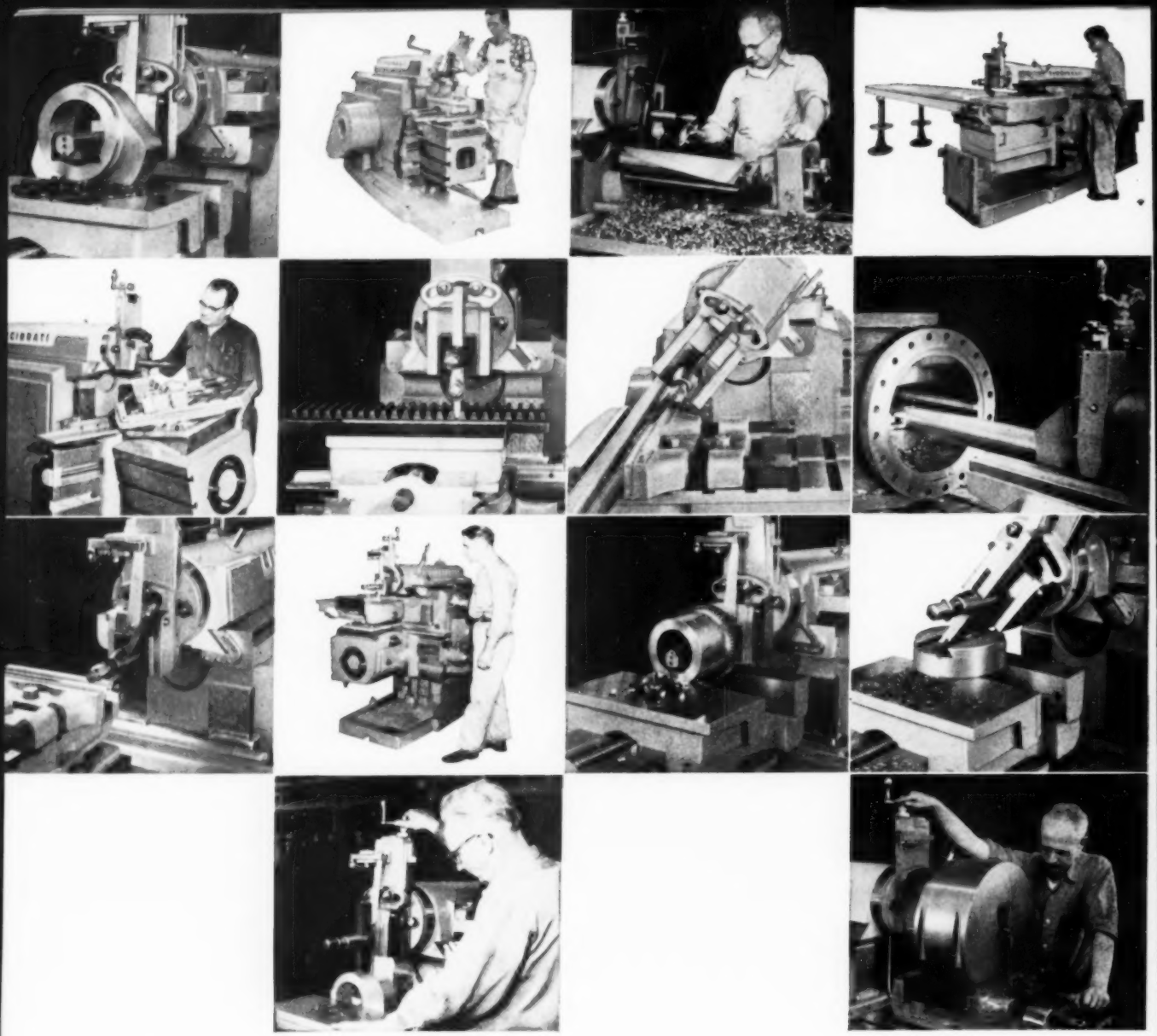
Watch Westinghouse for New Developments in Welding

CIRCLE 231 READER SERVICE CARD



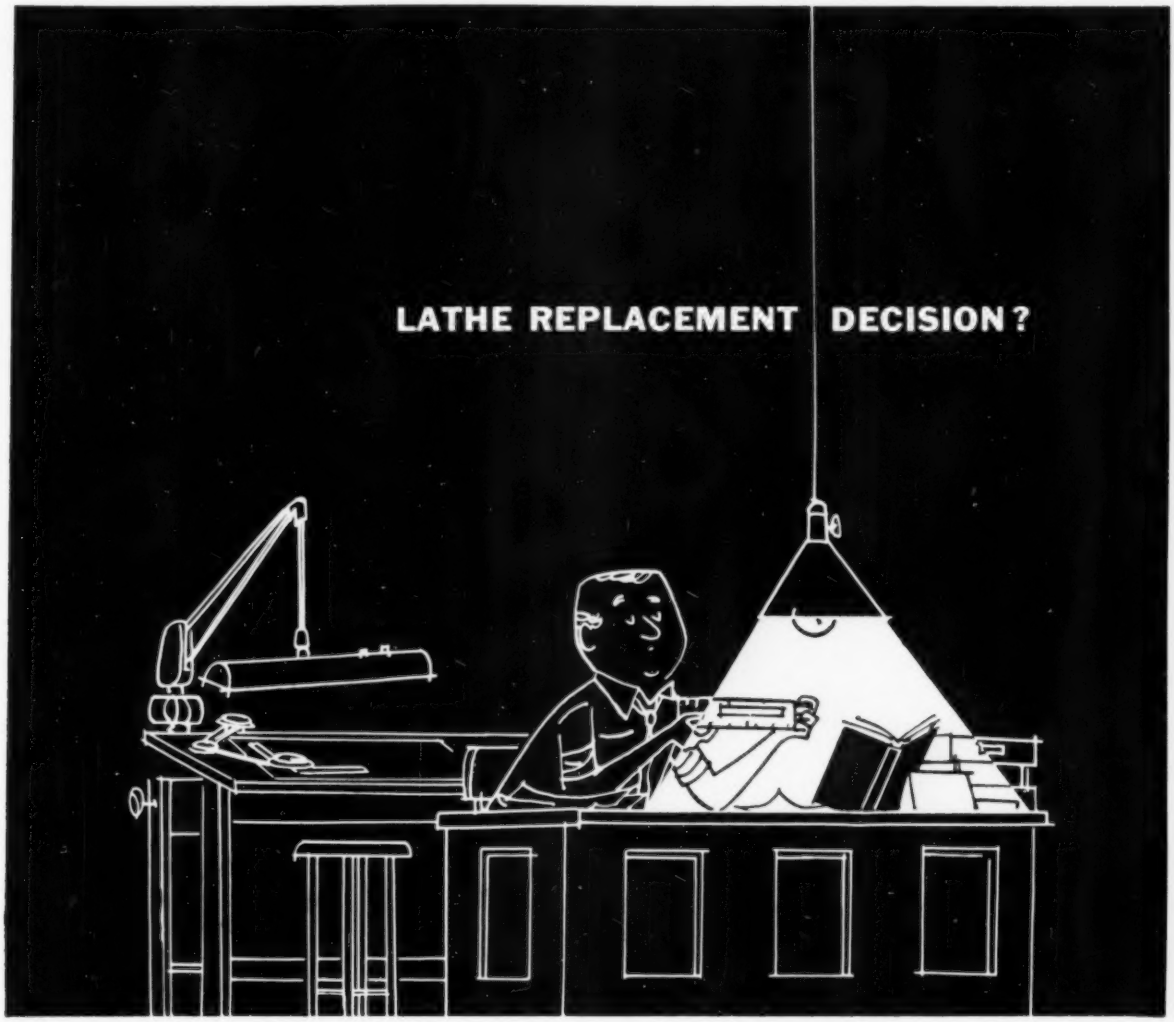
PAYOFF: VERSATILITY

In the tool shop or in your high production bay, the wide-ranging versatility of a Cincinnati® Rigid Shaper gives you maximum productivity for your invested dollar. And for each of the many jobs you can do on it, a Cincinnati Rigid Shaper produces something extra – in metal cut per hour, in accuracy, in ease of operation. See for yourself why a new Cincinnati® Shaper would pay off for you: write Dept. A for Catalog N-7.

Shapers / Shears / Press Brakes

THE CINCINNATI SHAPER CO. Cincinnati 11, Ohio, U.S.A.

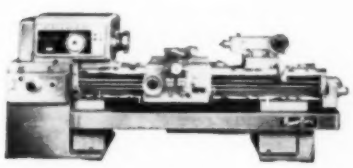
CIRCLE 232 READER SERVICE CARD



make it logical . . . . easier, too!

LOOK AT LODGE & SHIPLEY POWERTURN

Lodge & Shipley POWERTURN . . . faster, more accurate and specifically designed for newest cutting techniques and toughest alloys.



In turning . . . as in every manufacturing operation . . . there are "economic facts of life." Industry constantly demands more and better production at lower cost. This need has been filled by POWERTURN Lathes – demonstrated by case histories (available on letterhead request), which reveal thousands of dollars in cost reduction and higher output.

Base *your* replacement decision on a comparison of *any equipment* with the economic advantages assured by a really new Lodge & Shipley Lathe. POWERTURN facts will help you make a logical decision.

See details in Sweet's Machine Tool File, contact local representative through Yellow Pages or write direct for Bulletin L-104.

The Lodge & Shipley Co., 3056 Colerain Ave., Cincinnati 25, O.

Lodge & Shipley . . . your LODGE-ical choice

AIRCO INDUSTRIAL AND RARE GASES

ARGON
OXYGEN
ACETYLENE
NITROGEN
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HYDROGEN
CARBON DIOXIDE
HELIUM
XENON
KRYPTON
NEON

1. HIGH S-W RATIO. One of the most efficient of modern structural forms is the light-weight honeycomb assembly—dubbed the sandwich panel. Typical is this one, designed for the supersonic B-58, and providing the strength of solid steel at less than half the weight. Here's how it's made—

PART OF THE PICTURE

when Twigg makes the remarkable sandwich panel . . .

AIRCO INDUSTRIAL GAS SERVICE

2. "FOILED" FOR SUCCESS. Twigg Industries produce the sandwich panel for Convair. It calls for the most modern, most skillfully applied brazing technique.

Over each face of this stainless steel honeycomb "core" technicians lay a paper thin sheet of brazing alloy. And here Airco is part of the picture—as supplier of this vital silver-copper-lithium "foil," which must produce uniform, high-strength joints resistant to corrosion and extreme operating temperatures.

Next come the panel's stainless steel skin sheets.

3. IN THE BAG. Now chemically clean core, foil, skins, edge members and slugs are assembled and spot-tacked. Components pre-joined, the panel is weld-sealed within an airtight stainless steel bag.

At the purging station Airco again is part of the picture, supplying argon to replace the air in the bag.

4. BRAZED IN ARGON. Entire unit, now placed in a stainless steel retort in a furnace, is brazed for about 5 to 8 minutes at 1665°F. The atmospheres within both retort and envelope are purged continuously to maintain an environment of 100% Airco argon.

After the brazing cycle, the panel is chilled to −100°F with CO_2, reheated and X-rayed to make certain that fillets are completed and sound—an important step in the final checkout.

5. EVER-READY SUPPLY. From these Airco bulk trailers, argon and hydrogen are streamed directly into the Twigg brazing processes at Martinsville, Indiana.

More and more, the bulk trailers of Airco are part of today's industrial picture: they represent an economical way to assure an ever-ready supply of needed industrial gases.

Manufacturers in aircraft and missiles, steel, electronics, chemicals, food processing and many other industries rely on Airco for dependable supplies of high purity industrial gases.

Airco also supplies welding and cutting equipment and electrodes, and renders technical service covering all phases of gas and gas equipment applications.

Would you like to explore ways in which modern gas applications could improve your operation? Do you need a special grade of gas? Do you know how economical a permanent gas installation can be?

Call in your nearby Airco Engineering Service Representative. Airco backs him with unexcelled facilities.

AIRCO

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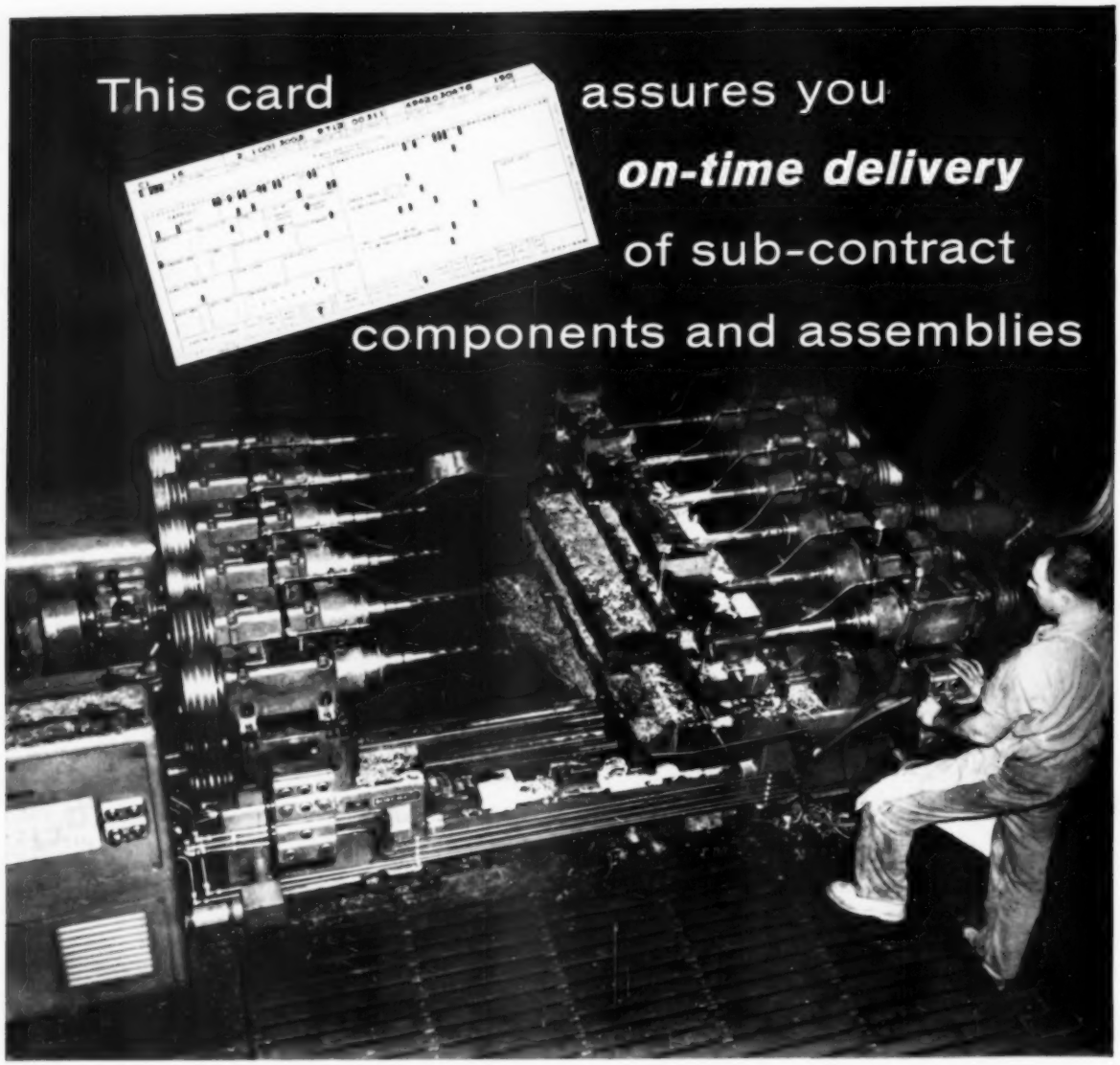
Offices and dealers in most principal cities • On the west coast—Air Reduction Pacific Company • Internationally—Airco Company International • In Cuba—Cuban Air Products Corporation • In Canada—Air Reduction Canada Limited • All divisions or subsidiaries of Air Reduction Company, Inc.

AT THE FRONTIERS OF PROGRESS YOU'LL FIND AN AIR REDUCTION PRODUCT • Products of the divisions of Air Reduction Company, Incorporated, include: **AIRCO**—industrial gases, welding and cutting equipment • **AIRCO CHEMICAL**—basic organic, inorganic, and intermediate chemicals, methyl butynol, methyl pentynol, and other acetylenic chemicals • **PURECO**—carbon dioxide—gaseous, welding grade CO_2, liquid, and DRY ICE ® • **OHIO**—medical gases and hospital equipment • **NATIONAL CARBIDE**—pipeline acetylene and calcium carbide • **COLTON**—polyvinyl acetate, alcohols, and other synthetic resins.



It's a small but important part of TMW's electronic punched card scheduling and control system. And it's your assurance that sub-contract jobs, regardless of size or quantity, are delivered *on time*.

You get this when you work with one of the world's largest, most modern and completely integrated manufacturers, whose 65 years' experience in precision (tolerance to 10ths) manufacturing is available to you *now* on either a short or long term basis.

Textile Machine facilities include 1200 modern machine tools of all types and sizes, a completely mechanized foundry (one of the country's largest), 3000 skilled craftsmen, plus a corps of the industry's top designers and engineers.

Combine these facilities with modern electronic production scheduling controls and quality control techniques . . . and you've got the perfect answer to all your sub-contract problems.

Write today for more detailed information, or for a copy of our latest Facilities File Folder.

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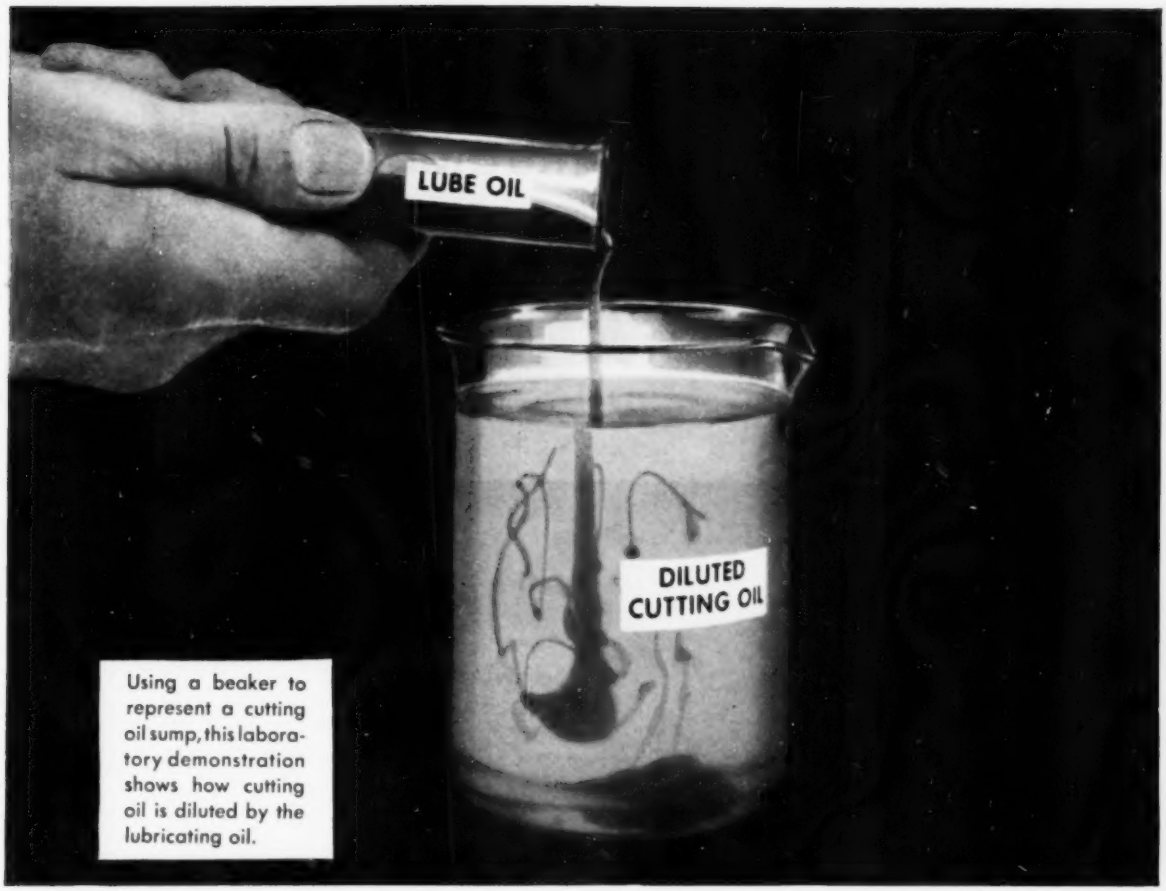
Contract Division • Reading, Pennsylvania



Using a beaker to represent a cutting oil sump, this laboratory demonstration shows how cutting oil is diluted by the lubricating oil.

Diluted cutting oil can cut output 33%

No matter how careful your lubricating techniques, you still can't stop lube oil from leaking into the cutting oil sump on 70% of automatic screw machines. As cutting oil is diluted, it loses strength—ingredients that make it efficient become less and less effective. The natural consequence is shortened tool life, more downtime and a higher percentage of rejects.

Texaco Cleartex can end this problem forever. All you have to do is use Cleartex for both cutting *and* lubrication . . . and watch your production rise. The exceptional chemical stability and load-carrying ability of the Cleartex series make them equally suitable for use as cutting oils, lubricants and hydraulic fluids. (70% of all automatic screw machines can benefit from the "Cleartex Cure!")

TAKE THE CLEARTEX CURE SOON!

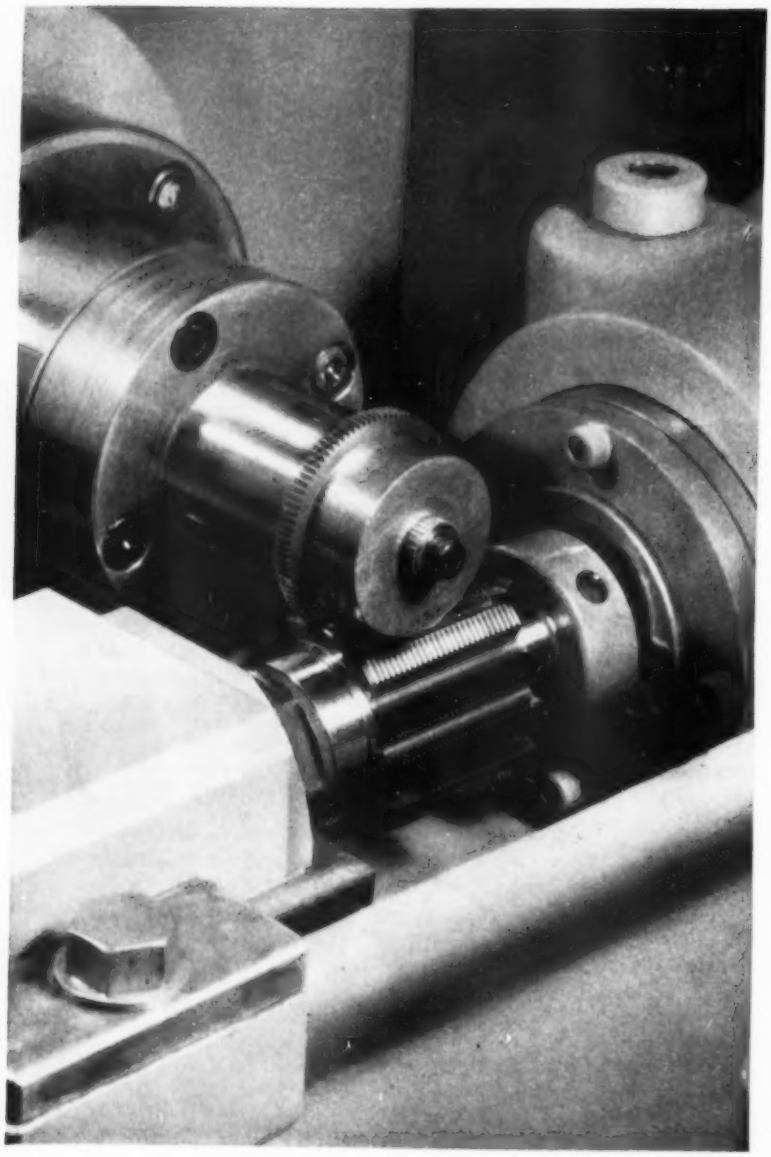
Write today for your copy of Texaco's new booklet—"Cleartex in Automatic Screw Machines." This new illustrated guide will fill you in on the details, show you where you may be losing profits and how to avoid it . . . Or contact your local Texaco Lubrication Engineer soon for an authoritative survey of your automatics. Just call the nearest of more than 2,000 Texaco Distributing Plants, or write to The Texas Company, 135 East 42nd Street, New York 17, New York. Dept. AM-11.

LUBRICATION IS A MAJOR FACTOR IN COST CONTROL

(PARTS, INVENTORY, PRODUCTION, DOWNTIME, MAINTENANCE)

New method of producing

AGMA Precision



Selection and segregation no longer necessary to insure precision-matched spur gear sets

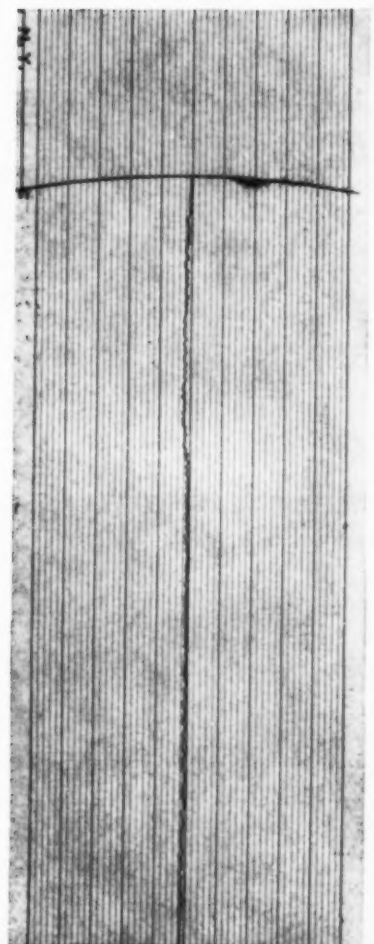
Selection and segregation — the process of producing more gears than you need in order to select a few that are within Precision Class 2 or Class 3 tolerances — is no longer necessary. And, these jobs at PIC Design Corporation, East Rockaway, L.I., New York, prove it.

In pioneering "Ultracision" accuracy for the missiles industry, Barber-Colman Company developed extensive machining and testing techniques now embodied in a new, low-cost hobbing machine — the No. 2½-4. For mass production of easily machinable parts which do not require such a high degree of accuracy, a high-speed version of this machine is available with a maximum hob speed of 2400 rpm.

Completely new hobbing machine

New concepts have been introduced into the Barber-Colman No. 2½-4 to bring you exceptional accuracy at a nominal cost. The No. 2½-4 is guaranteed to index accurately within 20 seconds of arc. This means that nonadjacent spacing error on a 2″ dia. gear would be only .0001″ due solely to the indexing error of the machine. When rigid tooling . . . accurate blanks . . . care in mounting the hob and work . . . Class AA hobs . . . and accurate hob-sharpening methods are used, it should be possible to hob AGMA Precision Class 2 and Class 3 gears without selection and segregation. Scrap and inspection time are reduced. And, in many

Class 3 Gears



Each line on tape represents .0001". This Precision Class 3 gear was obtained with only slightly more care than required for Class 2 gears.

cases, deeper savings can result from the elimination of finishing operations.

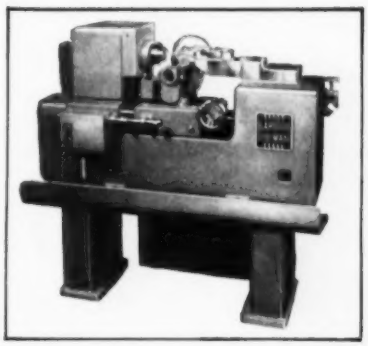
The accompanying PIC "true blue" gear tape shows the inspection record of a Precision Class 3 gear. On the production run, all gears had a total composite error of less than .0004". The gears have 96 teeth of 64 DP. The tape is made on a variable center-distance checking machine with a motor-driven master gear which rolls under preset pressure with the cut gear. After the work spindle adapter and the hob were trued within .0001", no further adjustments were necessary for hobbing gears of this accuracy.

The No. 2½-4 accommodates 3" dia. hobs, permitting maximum number of flutes for cutting accurate, smooth tooth profiles. Maximum work diameter is 2½" and length of cut is 2¼" — for steel gears as coarse as 30 pitch or brass up to 20 pitch.

PIC pursues accuracy in every corner of production

As you examine the results being achieved with the No. 2½-4 by PIC Design Corporation, you will see that in their pursuit of predictability and precision, no stone is left unturned.

Bores of Precision Class 2 and 3 gear blanks are machined to +.0002", -.0000" for size and roundness. Before turning, blanks are mounted on arbors the same size as the bores, with a .0002" taper. They are inspected for face wobble and must run true within .0002" per inch of diameter before the OD's are turned to a concentricity tolerance of .0001". This operation is checked at two points, 180 deg. apart.



In hobbing, the arbors are held in a floating adapter which permits fine adjustment to desired concentricity. PIC uses only Barber-Colman Class A or AA hobs, trued on the machine to less than .0001" runout.

Evaluate your gear processing and costs

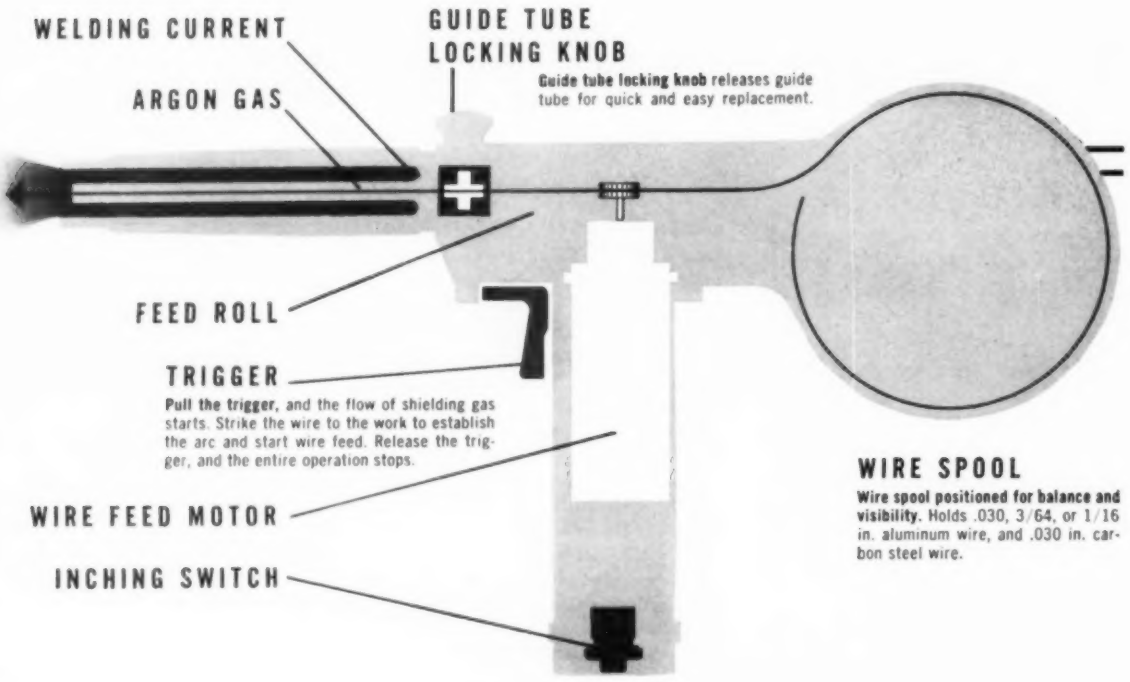
If you have the problem of producing precision fine-pitch gears at a profit or want to improve your product by increasing gear accuracy, a Barber-Colman process analyst will help you evaluate methods, tooling, and cost improvements. Phone your B-C representative or the factory — WO 8-6833.

Barber-Colman Company

BARBER COLMAN

41 Loomis Street, Rockford, Illinois

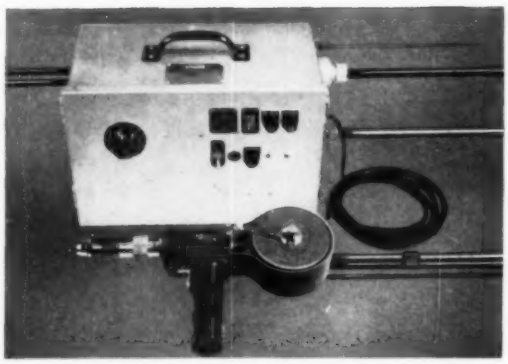
Try LINDE'S New "SIGMETTE" Torch!
–PORTABLE, COMPACT


WELDING CURRENT
ARGON GAS
GUIDE TUBE LOCKING KNOB
Guide tube locking knob releases guide tube for quick and easy replacement.
FEED ROLL
TRIGGER
Pull the trigger, and the flow of shielding gas starts. Strike the wire to the work to establish the arc and start wire feed. Release the trigger, and the entire operation stops.
WIRE FEED MOTOR
INCHING SWITCH
WIRE SPOOL
Wire spool positioned for balance and visibility. Holds .030, 3/64, or 1/16 in. aluminum wire, and .030 in. carbon steel wire.

Here's the torch that goes to the job—lets you work in any position . . . in confined spaces . . . at distance remote from the power source!

Designed for Sigma welding of light metals, the "Sigmette" torch is compact and sturdy. Notice the thin silhouette and position of the spool for complete visibility. Torch and control are completely insulated and grounded—the operator is protected from electrically "hot" parts. And the only maintenance tool needed is a screwdriver!

Find out how Linde's new "Sigmette" torch can speed your operations, bring new economies through its advanced design features. For a free demonstration and detailed information, mail the coupon today or call the nearest Linde Office.



Complete unit—torch weighs 3 pounds, 1 oz.; control weighs 19 pounds, 2 oz.; Current rating, 125 to 200 amp.; Welding power, direct current reverse polarity

Dept. AM-44, Linde Company
Division of Union Carbide Corporation
30 East 42nd Street, New York 17, N. Y.

☐ Please send complete facts on the new "Sigmette" torch.
☐ Please arrange to let me try it.

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"Linde", "Sigmette" and "Union Carbide" are trademarks of Union Carbide Corporation.

Linde UNION CARBIDE

Why The Mystery About Gage Materials?

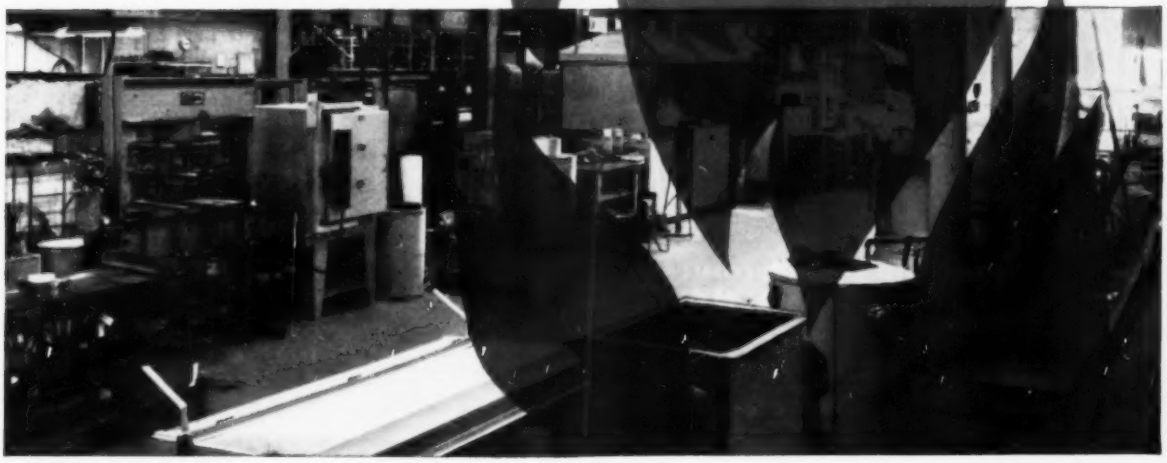
Extensive testing by The Pipe Machinery Company in customers' plants has proven High Speed Steel the best material developed so far for use in gages. Pipe Machinery is now offering working plug gages, through 1½" diameter, of this superior metal at no extra charge.

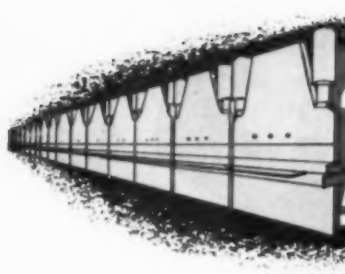
Years of experience has taught Pipe Machinery the best treatment for all their gage materials – and High Speed Steel is no exception. It is Nitrided for extra surface hardness in Pipe Machinery's own heat treating department where nothing is left to chance...where the most rigid standards guarantee uniformly high quality. As is the case with all Pipe Machinery gage materials, it is also submitted to a stabilizing treatment which further assures accuracy and long wear life for the finished gage.

Write today for additional information.

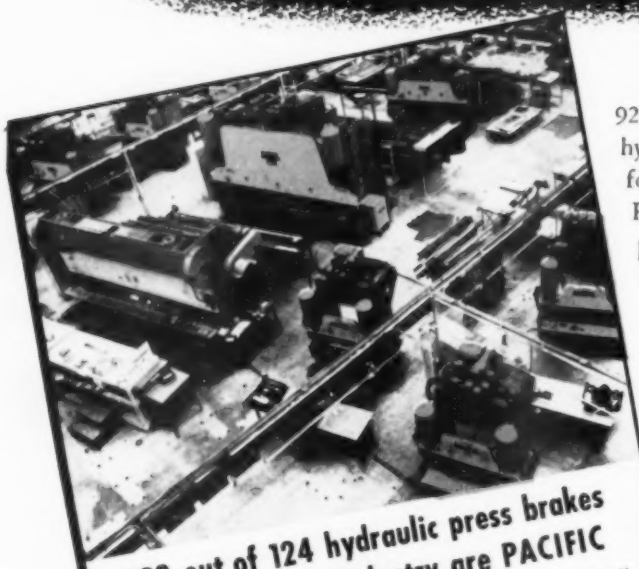
THE PIPE MACHINERY COMPANY

89100 Lakeland Blvd. • Wickliffe, Ohio
Greater Cleveland





4,769 years to arrive ACCURATE HYDRAULIC



122 out of 124 hydraulic press brakes in U.S. aircraft industry are PACIFIC

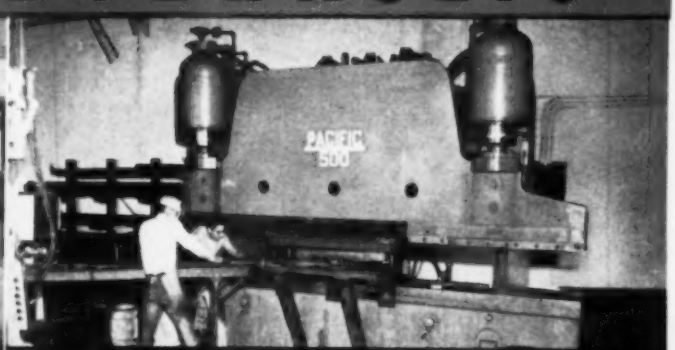
Aircraft manufacturers work to the closest tolerances of all industries in metal forming. Douglas Aircraft Company, Tulsa, Oklahoma, with 8 Pacific Brakes (above) is typical of the airframe manufacturers who have selected Pacific for its precise accuracy.

924 PACIFIC Brakes, representing over 95% of all hydraulic press brakes in use today, have operated for an aggregate of 4,769 years to test and confirm PACIFIC designs that have established hydraulic press brakes as far more profitable to operate than mechanical brakes. However, only PACIFIC has precise accuracy, versatility, high speed and dependability that comes from years of experience in manufacturing, developing and improving this unique machine. It is the only hydraulic press brake in daily operation that is actually air bending, straightening, deep drawing, blanking, and doing heavy punching. Accuracy within thousandths of an inch (greater than with any mechanical or other hydraulic brake) repeats itself on every stroke. Ram remains level regardless of location of work on the bed. PACIFIC sizes range from 60 tons to 1500 tons.

PACIFIC HYDRAULIC

Only hydraulic brake built for HEAVY PUNCHING

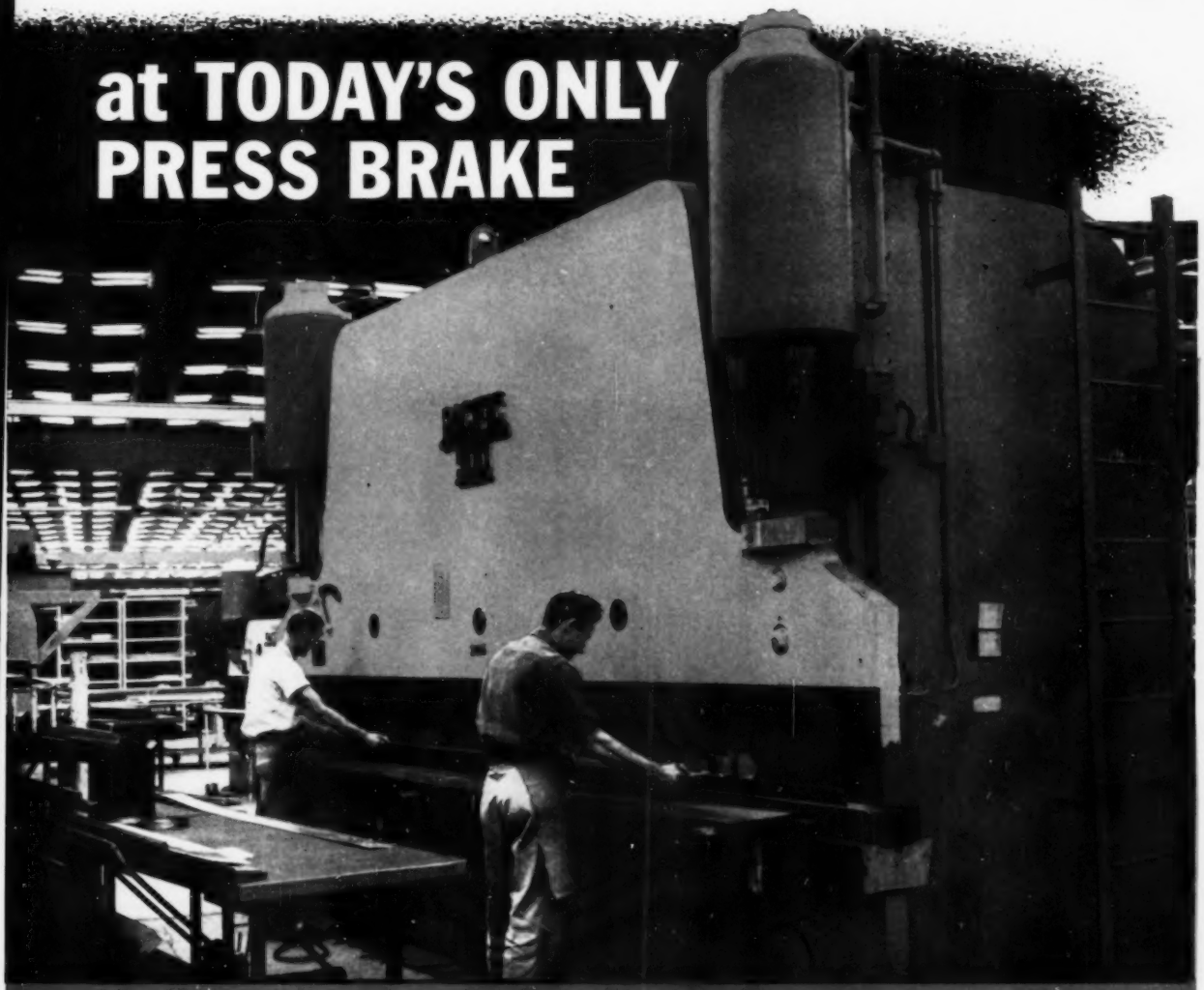
Pacific is uniquely designed to absorb heavy shock from punching in the hydraulic system rather than in the frame of the brake. Cushioned against shock, punch and dies stand up from 3 to 8 times longer than with mechanical brakes. Photo (above) shows 1" alloy steel plate being punched at earthmoving equipment plant.



MAINTENANCE-FREE for years

Dependable, simplified electrical and hydraulic controls can easily be kept working continuously by any plant maintenance crew. There are no complicated electronic devices. In photo (above) at agricultural equipment plant, the 500 ton Pacific Hydraulic Brake shearing ¾" alloy steel plate with Pacific Shearing Attachment has operated continuously for the first 4 years at a cost of $5.22 in replacement parts.

at TODAY'S ONLY PRESS BRAKE



PRESS BRAKE

HIGH SPEED operation

Pacific adjustable stroke length can be shortened for rapid stroking. Automatic, self-leveling ram permits use of progressive dies across entire bed of press. The automatically-fed Pacific at automotive parts plant, which can cycle up to seventy 1½" strokes per minute, is forming 3780 operations per hour in the above photo. In virtually any operation, Pacific's high cycling speed equals or exceeds materials handling capacity.

Write for brochure

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WITH EX-CELL-O BUSHINGS YOU GET TWICE THE AVERAGE BUSHING LIFE!

This was the result of competitive bushing tests recently conducted at a large automotive plant:

BRAND "A" 1,045 PIECES
BRAND "B" 1,910 PIECES
EX-CELL-O 2,255 PIECES
(per .001" of wear)

57-105

Ex-Cell-O Bushings outlast all others —give up to twice as much production

As a cost-conscious manufacturer, you recognize the importance of these results—independently arrived at—to your own operations. If you are not now specifying bushings stamped "XLO", you may be spending up to twice as much as you need be for every bushing you buy.

You certainly owe it to yourself—on the basis of this test alone—to discover the very substantial savings Ex-Cell-O bushings offer you. Test them—in your own plant—against any, or all, competitive bushings.

Send your order to Ex-Cell-O Corporation at Detroit, New York, Downey, Cal., Cincinnati, Ohio, and London, Canada. You'll get immediate shipment. Write for an Ex-Cell-O Drill Jig Bushing Catalog today.

EX-CELL-O CORPORATION
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EX-CELL-O PRECISION PRODUCTS INCLUDE: MACHINE TOOLS • GRINDING AND BORING SPINDLES • CUTTING TOOLS • RAILROAD PINS AND BUSHINGS • DRILL JIG BUSHINGS • TORQUE ACTUATORS • THREAD AND GROOVE GAGES • GRANITE SURFACE PLATES • AIRCRAFT AND MISCELLANEOUS PRODUCTION PARTS • DAIRY EQUIPMENT

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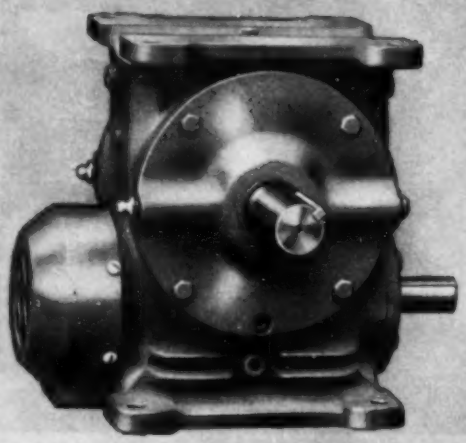
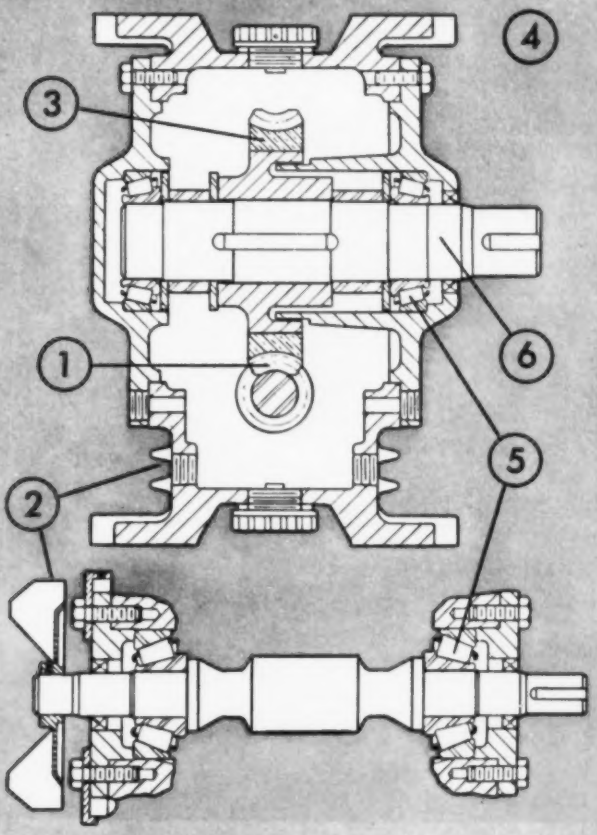
VERSO WORM GEAR SPEED REDUCERS

a new standard in worm gear design

smaller space and more horsepower per dollar





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1. Involute helicoid thread form has highest load capacity of any type of worm gear.

2. Fan cooling and ribbed construction give maximum effect of heat dissipation.

3. Centrifugally cast bronze dished gear—dry well construction.

4. Unit may be mounted in any position. Alternate mounting surfaces.

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6. Heat treated alloy steel gear shaft with bearing and sealing diameters provide a strength of 185% of an untreated shaft of the same diameter.

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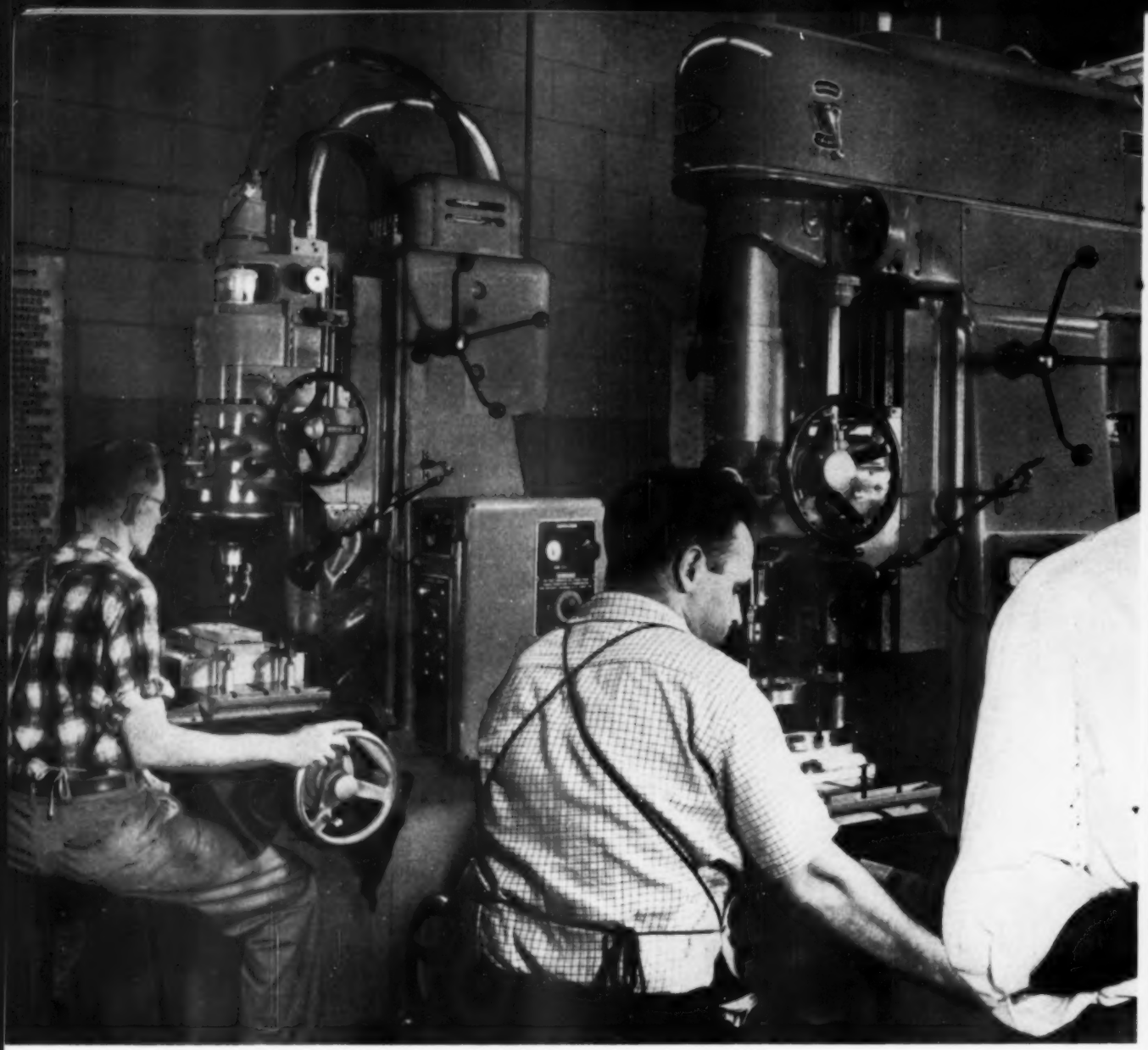
908 Nottingham Way, Trenton 2, New Jersey

DL444



"We're now splitting tenths, thanks to Moore's

say Karl Harig, chairman, and Herbert Harig, president of **Harig Manufacturing Corporation,** *Chicago*

"Our operators feel these are the best machines they have ever worked on...

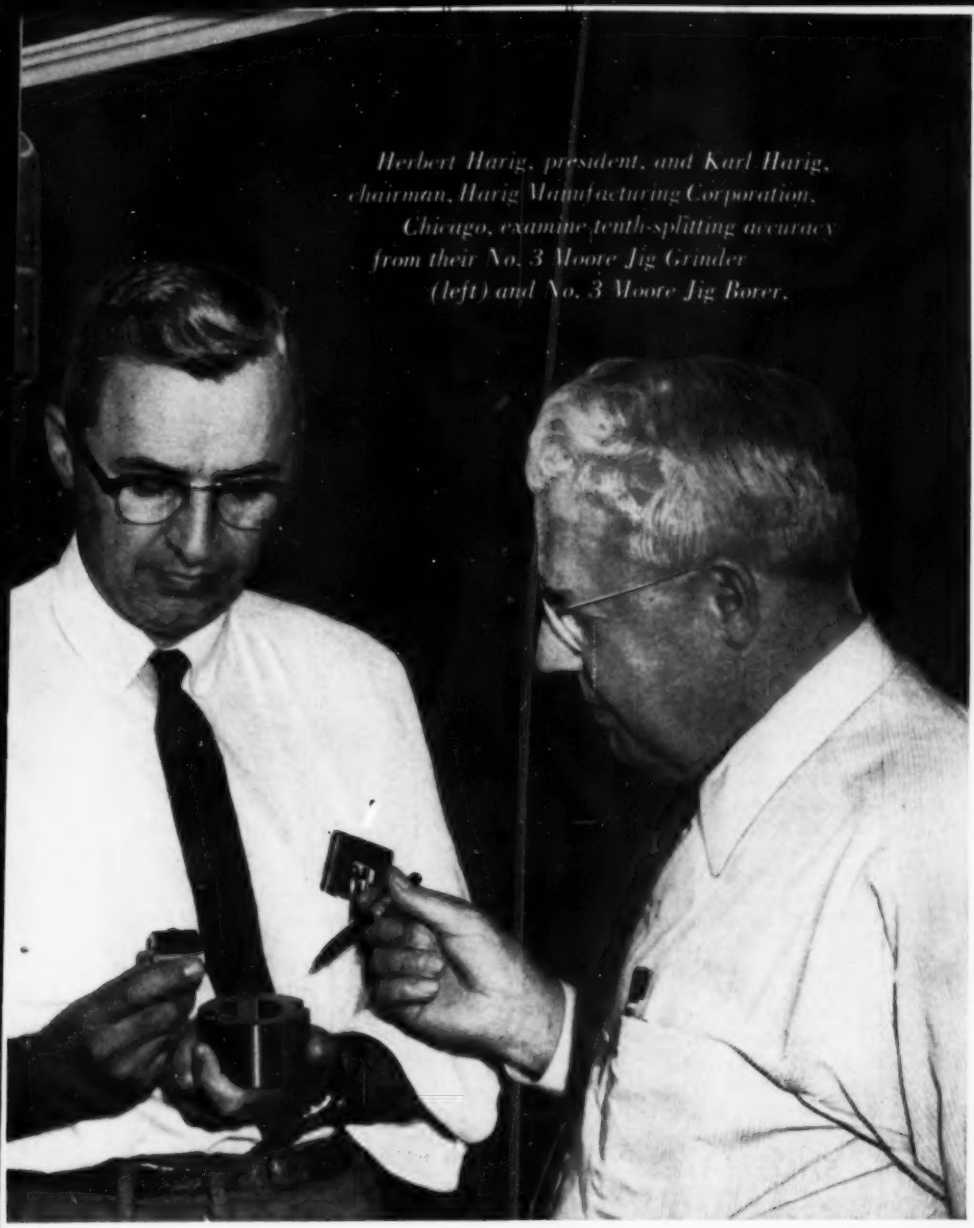
"Moore's No. 3 Jig Borer and No. 3 Jig Grinder take care of the tenth-splitting tolerances required by industry today..."

These are the words of two of America's acknowledged tooling leaders, active heads of one of the country's foremost independent producers of accurate dies—carbide, lamination, progressive, and other precision tooling.

Says President Herb Harig, former president of National Tool & Die Manufacturers Association:

"Moore's line of Jig Borers and Jig Grinders has been an integral part of the development and success of our company from 15 employees in 1937 to 120 today. We have always been

MOORE TOOLS **manufactured by**



Herbert Harig, president, and Karl Harig, chairman, Harig Manufacturing Corporation, Chicago, examine tenth-splitting accuracy from their No. 3 Moore Jig Grinder (left) and No. 3 Moore Jig Borer.

new No. 3 Jig Borer and Jig Grinder"

Made and calibrated to the new international inch.

among the first to install each new model. That's why we are among the first with Moore's tenth-splitting No. 3 Jig Borer and No. 3 Jig Grinder.

"As evidence of how indispensable we consider this equipment, over the years we have enlarged our Moore Jig Boring and Jig Grinding Department to 15 machines!"

Sums up Chairman Karl Harig:

"When owner-management invests its money in machinery, it does so only after thorough analysis and careful selection. I don't know of any machine tool manufacturer which meets both tests better than does Moore."

There's little more we can add, except to say that we stand ready to help you duplicate Harig's record of satisfaction. You can start by asking today for our detailed literature on the new No. 3 machines with their larger tables; hardened, ground and lapped ways; no gibs, no overhang.

Also, our dealer organizations will gladly share with you their extensive knowledge of holes, contours and surfaces (see column at right).

Moore dealers know holes, contours & surfaces

- Machinery Sales Company
  2838 Leonis Boulevard
  Los Angeles 58, **California**
- B-H-S Machinery Company
  717 Airport Boulevard
  South San Francisco, **California**
- Brett Machinery Company
  639 Madison Street
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- The Cameron & Barkley Co.
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  107 South Franklin Street
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- State Machinery Company, Inc.
  1800 North Meridian Street
  Indianapolis 2, **Indiana**
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  221 Third Avenue, S.W.
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MOORE SPECIAL TOOL COMPANY, INC.

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power hack saws
hole saws
band saws
hammers
ground flat stock
and for quick
dependable service
on all your
industrial needs

CAPEWELL

THE CAPEWELL MFG. CO.
HARTFORD 2, CONN.

Letters...

To American Machinist
330 W 42nd St, NY 36, NY

International standards

Dear Sirs:

Although your footnote to C E Bierwirth's letter (*AM*—Mar 9 '59, p78) does not flatly come out and say so, I suspect you feel that American Industry can only be served by cooperating with international standards organizations. I fully agree with this since it must be obvious that by standardizing on essential design features common to basic machine tools, screw threads, and numerous other items, we make our products more attractive to foreign customers.

It is indeed regrettable that the standards committee of the Saginaw Valley Chapter, ASTE, should have seen fit to resign in a body upon realizing that ISO (International Organization for Standardization) has Russian as well as Western members. Are they, and Mr Bierwirth, really so naive as to believe that our withdrawal from this organization would prevent the Soviets from getting the information they desire?

I am no more a Commie than the worthy members of the Saginaw Valley Chapter, but I do believe in fighting Soviet competition by realistic means. Crawling back into our shell and refusing to support international standards committees not only fails to accomplish its purpose, namely to withhold information from Iron Curtain countries, but will actually hurt American industries in the long run, because it will also tend to cut us off from important developments accomplished abroad.

Why cut off our nose to spite our face?

Walter O Rulf
The Waterbury Farrel Foundry & Machine Co
Waterbury, Conn

Steel-rule dies

Dear Sirs:

After reading the article, "Steel-rule dies cut stamping costs" (*AM*—Feb 23 '59, p111), I was very much impressed and would like to find more information concerning these dies, such as how they are made, etc.

The only reference I can find is that the article was written by Mr

SHOPMATES

N. Jarvis

THERE'S THE MEANEST MAN ALIVE!! HE KNOWS MAC FAG WAS BEHIND THE COMPRESSOR SMOKIN' BUT HE'S KEPT THE WHIP THERE AN HOUR BRAGGIN' ABOUT HIMSELF!!
— BLA BLA BLA — EIGHTY YARD RUN — BLA BLA — BIGGEST TROUT EVER CAUGHT — BLA BLA — SO I SEZ "LOOK HERE GENERAL"!! BLA BLA — ETC ETC —
N. JARVIS

Hoover pillow blocks with ductile cast housings

Hoover introduces a new, economical pillow block ball bearing unit with cast housing of ductile material that absorbs shock and vibration, assuring long bearing life. It is designed to carry light loads at normal speeds.

The unit contains a pre-lubricated bearing featuring ultra-smooth *Hoover Honed* raceways and a perfectly matched set of *Micro-Velvet* balls, a guarantee of unexcelled quality. Known as the E D series, these new pillow block bearings are available in shaft sizes from ½" to 1 3/16".

Hoover also offers a cast iron pillow block bearing for light to medium load conditions, plus a wide range of flange and machine units.

hoover

BALL AND BEARING COMPANY

5400 South State Road, Ann Arbor, Michigan

Sales Offices and Warehouses: 2020 South Figueroa, Los Angeles 7, California | 290 Lodi Street, Hackensack, New Jersey

Hoover Honed and *Micro-Velvet* are Hoover trademarks.

NEW BULLETIN 106 DESCRIBES COMPLETE LINE OF NEW HOOVER PILLOW BLOCK BALL BEARINGS!

Please return coupon for your copy

AM-4

Hoover Ball and Bearing Company
5400 South State Road, Ann Arbor, Michigan

Please send new Bulletin 106, which describes Hoover pillow block ball bearings.

Name_____

Title_____

Company_____

Address_____

City_____ Zone_____ State_____

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Roll Marks 6,000 Pieces Per Hour

Here is another Noblewest achievement for faster, better marking at lower cost. Designed and built by Noblewest especially for high production marking of thin walled cup-shaped parts or tubes. Model 482, illustrated, is shown tooled for ***Roll marking*** a famous name garden hose accessory. Operator simply loads the parts onto the work feed dial. From that point the process is completely automatic.

Whatever your requirements for *permanently indented* marking, you are assured of the finest machines and marking tools when you specify Noblewest.

Write for new comprehensive catalog. Noble & Westbrook Manufacturing Co., 17 Westbrook St., East Hartford 8, Connecticut.

Noblewest precision marking dies and tools are the standard for quality and long life. Large facilities permit excellent delivery at competitive prices.

A few desirable territories open to qualified representatives

MARK IT BEST WITH NOBLEWEST IMPROVED MARKING DEVICES

NOBLEWEST

ORIGINATORS OF THE ROLL MARKING PROCESS

MARKING · NUMBERING · EMBOSSING · GRADUATING

Charles Hazzard, Vice President of Templet Industries, Inc, Brooklyn. Would you be so kind as to forward me his address so that I may correspond with him and receive more information on the above?

Otto M Huffman
Shippensburg, Penna.

Dear Sirs:
This is an excellent article by Charles Hazzard, and he has our interest whetted up. Where can we get some more information on steel-rule dies? We would like to make up a few for evaluation.

John Thomas
Lindsay, Ontario

Dear Sirs:
Would you please be so kind as to give us the address and phone number of Templet Industries, Inc, Brooklyn . . . ?

Joske's de Mexico
Mexico, DF

Dear Sirs:
I would like to know where I can get further information on construction and source of materials for steel-rule dies. . .

Albert E Glastetter
Johnson City, NY

You will be able to secure additional details by writing directly to Templet Industries: Mr E H Rheingold, President, Templet Industries, Inc, 702 Atkins Avenue, Brooklyn, NY. Other applications of the steel-rule-die technique have also been reported in earlier articles in AM, for example, Dec 2 '57, p 119—Ed

"Beginning next week you get a more responsible position and a slight increase to pay for the extra milk for your ulcer."

CALENDAR

National Screw Machine Products Association — Annual Meeting, Apr 26-30, Roosevelt Hotel, New York, NY.

Grinding Wheel Institute & Abrasive Grain Association—Joint Spring meeting, Apr 27-29, The Homestead, Hot Springs, Va.

American Society of Mechanical Engineers—Metals Engineering Conference, Apr 29-May 3, Sheraton-Ten Eyck Hotel, Albany, NY.

American Institute of Electrical Engineers — Automatic Techniques Conference, May 11-13, Pick-Congress Hotel, Chicago.

American Society of Mechanical Engineers — Production Engineering Conference, May 12-14, Statler-Hilton Hotel, Detroit, Mich.

Machinery Dealers National Association — Annual Convention, May 13-15, Plaza Hotel, New York, NY.

American Supply & Machinery Manufacturers Association — Triple Industrial Supply Convention, May 13-15, Dallas.

American Institute of Industrial Engineers—National Conference and Convention, May 14-16, Biltmore Hotel, Atlanta, Ga.

Magnesium Association — Annual Meeting, May 18-19, The Cloisters, Sea Island, Ga.

Design Engineering Show—May 25-28, Convention Hall, Philadelphia, Penna.

American Society for Quality Control — Annual Convention and Exposition, May 25-27, Public Auditorium and Hotel Cleveland, Cleveland, Ohio.

American Gear Manufacturers Association — Annual Meeting, May 31-June 3, The Homestead, Hot Springs, Va.

Material Handling Institute—National Exposition, June 9-12, Public Auditorium, Cleveland.

National Association of Metal Finishers—Annual Meeting and Convention, June 14-16, Statler-Hilton Hotel, Detroit, Mich.

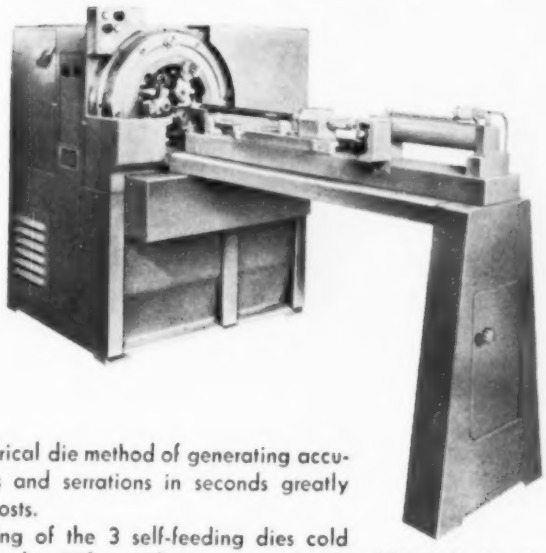
Reed 3-Cylindrical Die Machine

. . . produces splines faster with greater accuracy

It's Fast ...

It's Accurate..

It's a Money Maker ...



The Reed 3 cylindrical die method of generating accurate involute splines and serrations in seconds greatly reduces production costs.

The precise tracking of the 3 self-feeding dies cold forms the teeth with either 30° or 45° pressure angles. It gives greater tooth strength and better surface finish. The machine may be automated or equipped with a semi-automatic loading fixture.

Write today for detailed information.

If it can be rolled—write Reed.

REED RD SM-175

REED ROLLED THREAD DIE CO.

Specialists in Thread and Form Rolling Tools and Equipment

HOLDEN, MASSACHUSETTS, U. S. A.

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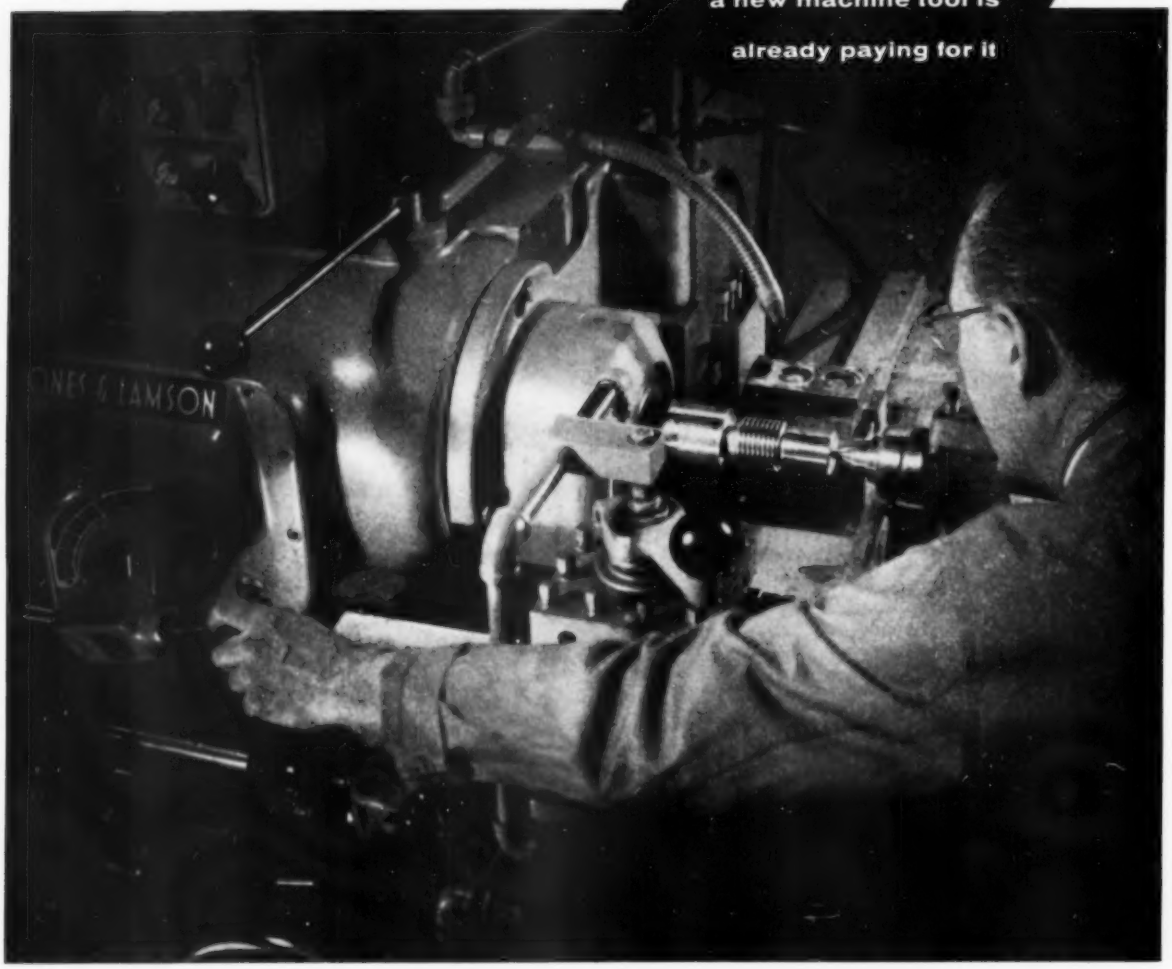
CIRCLE 251 READER SERVICE CARD

JONES & LAMSON MACHINE TOOLS

the man who needs
a new machine tool is
already paying for it



The Turret Lathe with a fully automatic thread-chasing cycle!

Here is full turret lathe versatility and a threading attachment with a fully automatic cycle — all in one machine. Now you can be sure of concentricity of threading with other lathe work, *all done in one chucking*, with the time saving of the Auto-Threader!

This Auto-Threader will chase straight or taper threads — or a combination — internal or external, from the front of the machine.

Other features include: uniform thread length, by means of positive stop and follower nut disengagement together with rapid tool withdrawal; precision lead control by full depth follower nut engagement on a hardened and ground leader.

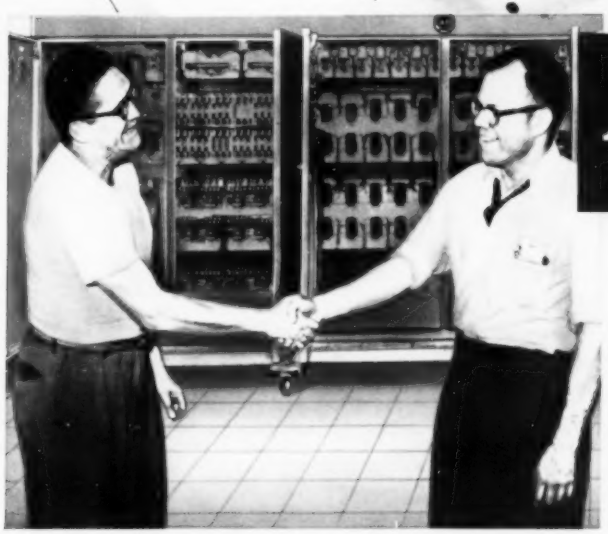
Write for descriptive folder No. 5440. Jones & Lamson Machine Company, 502 Clinton Street, Springfield, Vermont.

Turret Lathes • Fay Automatic Lathes • Precision Boring Machines • Thread & Form Grinders • Optical Comparators • Thread Tools

CIRCLE 252 READER SERVICE CARD

CIRCLE 253 READER SERVICE CARD ▶

Precision Guidance of Nearly a Mile of Plate Glass...



A series of control panels such as this is used in the Pittsburgh Plate Glass cutting room. Above are shown the Allen-Bradley engineers after completing the factory testing of the final panel.

controls by ALLEN-BRADLEY of course!

The New Pittsburgh Plate Glass Plant at Cumberland, Maryland, heralds a new era in the art of plate glass making. Night and day, a continuous ribbon of glass is fed to a nearly mile-long process line. Then a complex control system directs the automatic cutting, sorting, and conveying of the glass to six areas, according to a continuously varying program.

Special control panels which integrate portions of this equipment into a unified, smoothly operating system were designed, developed, and engineered by Allen-Bradley. You can benefit by this extensive control experience . . . it is a "plus" value when you specify Allen-Bradley *quality* motor control.

Allen-Bradley Co., 1316 S. Second St.
Milwaukee 4, Wis.
In Canada: Allen-Bradley Canada Ltd., Galt, Ont.

See on the next page how A-B Controls do it...

5-59-MR

Plate Glass made by the mile

with reliable ALLEN-BRADLEY Controls

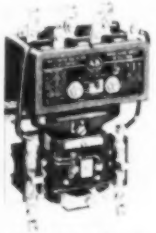
A-B QUALITY

In the cutting room at Pittsburgh Plate Glass (below), Allen-Bradley controls prove the reliability of their "simple design." All A-B solenoid starters, contactors, and relays have only ONE moving part . . . assuring *millions* of trouble free operations. There are *no* bearings or jumpers to cause trouble. Contact maintenance is also eliminated — A-B double break, silver alloy contacts remain in perfect operating condition until completely worn away. Insist on Allen-Bradley *quality* motor controls . . . you cannot do better!

Among the A-B components included in this group of control panels are contactors, control relays, pneumatic timers, and electronic timers. In addition, there is a series of oiltight push button units and oiltight limit switches used in the cutting room.

Some of the standard components which are used in this plant

Contactor—Bulletin 702, Size 3 shown. Made up to Size 8, rated 1350 amps, 220-550 v.



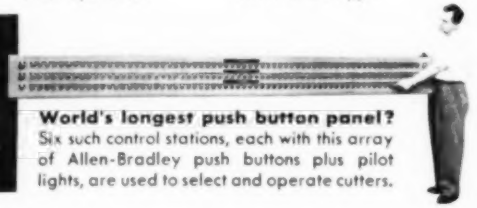
Solenoid Starter Bulletin 709, Size 2 shown. Made in ratings to 450 hp, 220v; 900 hp, 440-550 v.

Control Relay—Bulletin 700. Universal type relay with both N.O. and N.C. contacts shown.

Limit Switch—Bulletin 802T. Oiltight roller lever type shown. Also with many other operators.

Pneumatic Timer Bulletin 849 for on-delay or off-delay. Range from 1.20 to 180 sec ±10%.

ALLEN-BRADLEY
Quality Motor Control



World's longest push button panel? Six such control stations, each with this array of Allen-Bradley push buttons plus pilot lights, are used to select and operate cutters.

Allen-Bradley Co., 1316 S. Second St., Milwaukee 4, Wis.
In Canada: Allen-Bradley Canada Ltd., Galt, Ont.

5-59-MR

SPOT NEWS...

- **An electric car** that operates from sintered-plate, nickel-cadmium batteries constantly recharged from a small, high-performance gasoline engine, may be the offshoot of a joint R & D project by American Motors and Sonotone Corp—but it may take several years before the two companies produce a car that is "feasible or economic."

- **Army is quietly breaking up its idle machine tool lines,** ones which have been maintained for standby defense production for several years. An example: as recently as 2½ years ago, the Army had production lines on standby at 18 artillery ammunition plants, now it has only three. Similarly, at Korea's end the Army had four medium tank lines on standby, now there is only the Newark, Del, line that hasn't been broken up.

- **Any company that does not take steps** to adopt numerically controlled machine tools soon "may well find its products priced out of the market in the 1960 decade," in the opinion of USAF Lieut General C S Irvine, Deputy Chief of Staff, Materiel (see Aircraft & Missiles, p95).

- **Lockheed Aircraft has purchased a controlling interest** in Puget Sound Bridge & Dredging Co, Seattle. Object: to use the shipyard for construction of nuclear-powered, missile-firing Polaris subs, which Lockheed Board Chairman R E Gross says are the "capital ships of the future."

- **On display at a recent Pentagon conference on gas turbines** for non-aircraft defense uses: GM-Allison's 605-lb engine which runs on kerosene or JP-4; Curtiss-Wright's Turbomite, a 2.5-kw gas turbine generator now being developed for the Army and which weighs so little (40 lbs) it can be carried on a soldier's back; Chrysler's experimental auto gas turbine, which weighs half as much as a piston engine; and Ford's turbine, which weighs one-fourth as much as a diesel truck engine, produces 300 hp.

- **Lockheed Aircraft has just formed a subsidiary,** Lockheed Aircraft International, to "develop broad aviation programs in foreign nations," i.e., to farm out its skills and experience to help other nations set up aircraft manufacture, sales, repair, missiles, electronics programs.

- **An "anti-satellite" vehicle and an "anti-ballistic missile"** are now being developed by Boeing's Pilotless Aircraft Division.

- **Chrysler will award pilot line production of the new M-60** medium tank, will turn out 180 of the diesel-powered, 105-mm-gun equipped tanks during a three-month period in mid-1960 at Newark, Del.

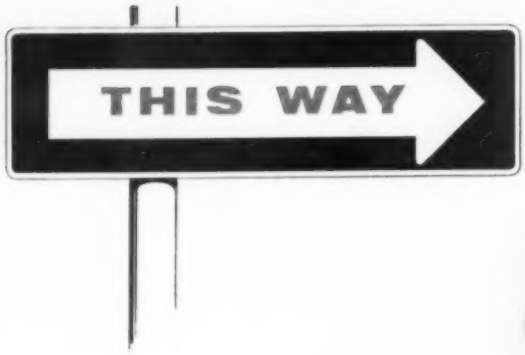
- **Government may soon change its mandatory classification** of a "small business" from 500-or-fewer employees to 1000 employees or fewer.

- **Ford plans to build a $15-million truck plant in Argentina** with an ultimate capacity of 18,000 vehicles a year. About 40% local materials will be used at the start. No site has been chosen as yet.

- **Cleveland's Rand Development Corp has set up a Moscow office** "to study Soviet technical and scientific developments for possible use in the United States." One such development: a refrigerator that employs semiconductors, has no moving parts, is noiseless, vibrationless.

- **Red China has placed more than $64 million worth of tractor orders** with British firms since mid-1957, when the tractor embargo was lifted.

- **Russia's new electro-slag welding process has come to the U S**—an automatic machine produced in Belgium under Czech license will be sold here by Amalgamated Industrial Corp of Philadelphia under the name "Vertomatic." It butt welds plates 1 to 20 in. thick. Molten pool of weld metal (up to 40 lb/hr) solidifies as joint fills. (*AM*— Jan 12 '59, p106).



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WASHINGTON... TRENDS

Military looks at gas turbines...

The role of non-aircraft gas turbine engines in military procurement has gotten a big lift from a special Pentagon conference this month. Fourteen turbine makers met with officials from almost every defense procurement agency to tout their product.

While gas turbines have taken over the military aircraft propulsion market, they've yet to make their mark in military procurement of automotive, stationary power, and auxiliary power engines.

The military does buy gas turbines for operational use as power sources for aircraft and missile ground support equipment. But in the automotive and main power fields, gas turbine engines are essentially still in the experimental stage.

One result of the conference may be a relaxation of military specifications to provide for bids from gas turbine engine builders. In many cases, military specs—for radar stations, for example—are geared to conventional powerplants, make no provision for installation of gas turbines.

As Pentagon research and development experts see it, the conference brought the state of the art in non-aircraft gas turbines to the attention of so many procurement officials that it's inevitable such restrictions will be lifted.

Liberalized renegotiation?

The controversial Renegotiation Act will be renewed for two years, but the outlook is for some liberalization. Under the law, which expires June 30, the government recovers defense contractor profits ruled "excessive" by the renegotiation board.

The Pentagon wants an amendment that would make it easier for producers to share in economies made under incentive-type contracts. Under these provisions, contractors' profits are progressively boosted when and if production costs are held under initial estimates.

The proposed amendment would make the Board "take into consideration . . . the particular nature and objectives of the contractor's efforts thereunder." Type of procurement contract is now omitted from the statutory factors the Board must consider in determining excessive profit.

Defense contractors have urged exemption of incentive-type contracts from renegotiation. In many cases—notably the pending Boeing appeal from a $20-million excessive profit ruling—the Board has challenged the contractor's right to additional profit earned under incentive arrangements.

Also proposed: (1) The Board to show more clearly official evaluations of excessive profit rulings; and (2) contractors to be allowed to appeal tax court decisions in the federal courts.

A bill being pushed by Rep King (D, Calif) would liberalize renegotiation even more. It would establish "a comparison (of defense contractor costs and profits) with . . . other industries" as an additional factor in determining excessive defense profits, and guarantee a rate of "agreed profits" under which the Renegotiation Board could not go. Odds are Congress will vote the administration-proposed measure.

Stress on missile reliability...

The Pentagon is under serious pressure to stress even more reliability of missile components. The pressure comes from a House Appropriations Committee study of reliability efforts in ballistic missile projects. Committee experts report that (1) industry has not produced sufficiently durable and reliable components, (2) there is inadequate testing of components in advance of assembly, and (3) military inspectors and inspection techniques have not "kept pace with the advancing complexities of modern weapons."

The Pentagon is urged to write reliability requirements into military specifications. Where this is not practical, the Committee wants contractors to be required to "adopt and maintain definite programs of training, indoctrination, workmanship review, and inspection in support of reliability achievements."

How good *is* the labor outlook?

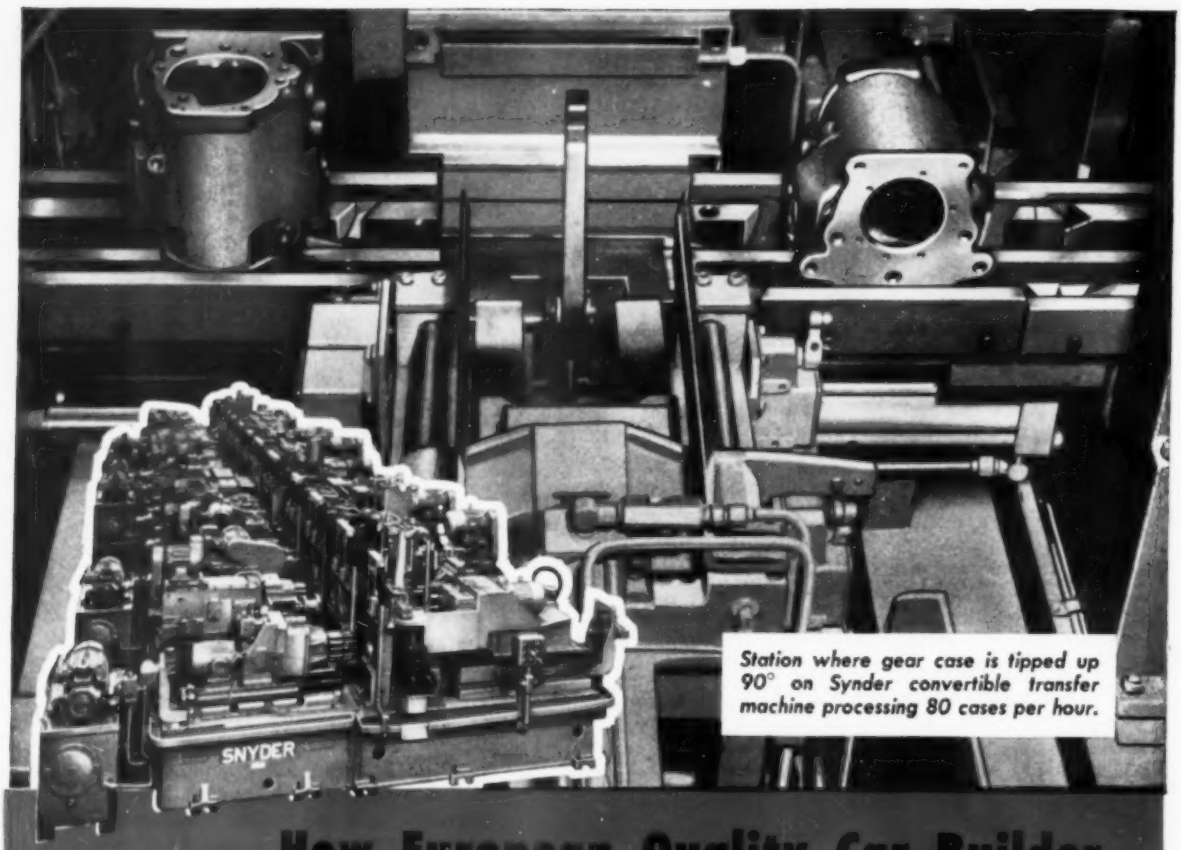
Organized labor and the administration are at loggerheads over the administration's ballyhooing of March employment figures.

These statistics show a 150,000 advance in the number of manufacturing employees, which is "significantly better than usual."

Furthermore, overall unemployment now stands at 5.8% of the workforce, just about where it was in January, 1958, before all the unemployment troubles started. The administration predicts this rate will carry through October, when 5.8% unemployment would translate into an actual count of just over three million.

But labor leaders pooh-pooh the administration's pointing with pride to the March figures.

Say the labor people: hard-core unemployment is still critical, hundreds of thousands of jobs have been lost permanently to the machine. What labor now wants is extensive federal aid to the unemployed and federal creation of jobs.



Station where gear case is tipped up 90° on Synder convertible transfer machine processing 80 cases per hour.

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DETROIT...

Auto sales boom...

Ford Motor Co, ethically withholding its good news until a stock issue had been oversubscribed, has really put the bloom on spring.

Ford Division on March 31 sold 6500 cars, the highest single day of the year, and 30% better than the daily average for the month—not that this was bad, either. Total March sales were a whopping 64% better than in 1958.

Thunderbird has already sold half as many cars as were sold during the entire 1958 model year. Mercury is running 7% ahead and Edsel 5%. Only Lincoln and Continental are lagging slightly, but this is mostly due to emphasis on T-bird production.

Overall Ford performance, coupled with plenty of good sales news from other quarters, has caused some more optimistic auto executives to set sights on a year at least as good as 1957 when 6,113,344 cars were produced. Ford Division itself has accordingly increased its April car production schedules 20% over plan.

Any remaining doubt seems adequately dispelled by Chevrolet, which reports passenger car sales up 21% over March of 1958. And better still, the selling pace is accelerating. General Manager E N Cole says that "If the current public demand for our product continues, Chevrolet should record one of its best sales years in history."

Pontiac, meanwhile, is enjoying its highest daily sales rate since 1955. March deliveries were up 82.9% over last year, boosting the division to first place in the medium-price field. Cadillac finished the quarter with an all-time record of 39,491 vehicles, topping 1957 by a mere 41 units. Buick and Oldsmobile have both posted fairly substantial gains over 1958, but no records.

Chrysler Corp, despite strike losses, has already out-produced its 1958 year-to-date total by 30,000 units. Dodge has shown the most marked increase, with a total of 44,885 cars compared to 26,000 last year.

Ramblers and Larks...

Sales of these makes have reached the point that perhaps calling them the "Little Two" is a misnomer. Rambler's March sales total of 29,895 cars almost exactly doubles the 1958 figure. For the company's fiscal year, which starts October 1, sales are up 139% and that is an increase over a previous record.

Burgeoning Studebaker had its best March, with 14,207 passenger car sales, since 1953. Schedules have been upped to 84 units an hour and a further increase is expected to avoid expensive overtime. Saturday work has stopped, but an average weekly output of 3700 units is being maintained.

Used car prices, a hardy barometer of auto business, are up 28% (for four-year-old units) over the low point registered in 1956.

Only 55% of new car buyers are using installment credit, compared to more than 63% during the past two years.

Trucks of all sizes are making a real comeback. Chevrolet reports a 41% better March sales total this year. Ford's first quarter truck total is 40% ahead of 1958. Dodge has nearly doubled its production pace. Other makes, including GMC, IHC, Willys, Studebaker, and Mack are all well ahead of 1958.

Trends in foreign cars...

Main idea of exhibitors at the New York International Auto Show, which closed April 12, seemed to be to get foreign car prices down to where they can compete with U S prices.

Their target: the man who wants a good-looking, well-built car he can drive himself—one that's easy on gas and tires, is easy to maintain. That's why cars in the under-$3000 bracket predominated at the Show.

Two countries have had a decided influence on this year's foreign car styling—Italy and the United States. Americanization showed up in optional power steering, power brakes and automatic transmissions for low priced makes.

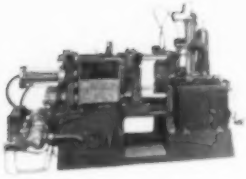
The Italians influenced style to such a degree that about half of all British makes shown, and a large percentage of the German ones, too, owed something to Pinin Farina and other Italian designers. (Hallmarks of Italian design: simplicity, lack of chrome, smooth body lines, lots of glass.)

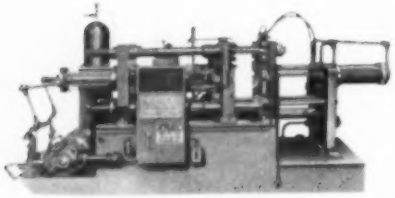
Best example of Italian influence was the new Aston-Martin DB 4, a two-door, four-passenger job equipped with an aluminum engine. It'll do 140 mph.

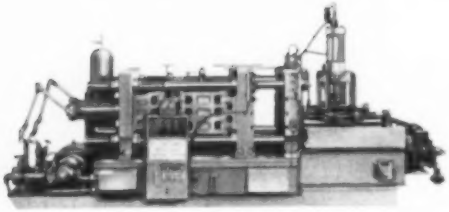
Tailfins were much in evidence this year. And while they're generally credited to the United States, they're actually an Italian innovation dating back to 1946.

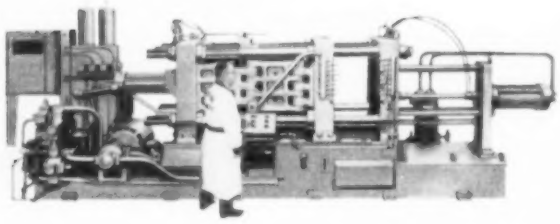
Mechanically, European cars on display ranged from ½ liter (30-cu-in.-displacement) miniature "bubble cars" such as the Goggomobile to Rolls-Royce and Bentley 3-liter sedans designed strictly to catch the carriage trade.

Foreign makers are paying a lot more attention to brakes this year, mainly because U S turnpikes permit much higher speeds than are attainable in Europe. Trend is toward disk brakes, aluminum brake drums, vented wheels.









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AIRCRAFT and MISSILES...

TRENDS

The case for numerical control...

Air Force's Lieut General C S Irvine, USAF's Deputy Chief of Staff for Materiel, took up the cudgels for numerically controlled machine tools at the recent Purdue University Conference on Numerical Control.

"Specific advantages of numerical control as I see it," he said, "fall into three broad categories: (1) reduction in time, (2) more output per dollar, and (3) much greater accuracy."

In certain tool fabrication jobs, he said, work time has been cut as much as 90% (on complex die sets) with numerically controlled machine tools. Another example: time for machining a wing-reinforcing doubler part was cut from 25 hours to one hour and six minutes.

On the subject of numerical control-induced economies, General Irvine cited the case of a company that cut the cost of making a certain die from $4000 to $455. In another instance, tooling needed for one forging on a tracer-type machine cost $33,772. The same forging cost $7625 to make on a numerically controlled setup.

Regarding accuracy, the General said that on hard tooling (airfoil or leading edge dies, hot sizing and creep form dies) numerical control machining has lowered tolerances from 0.020 in. to 0.005 in. and, he said, "I am told that accuracies of 0.001 in. can be furnished."

"NCMT's are here and they are here to stay," the General added, "The economies stemming from them constitute a major breakthrough in manufacturing."

The company that does not take steps toward adopting NC, the General said, may well find its products priced out of the market by 1960-1970.

Make or Buy again...

Air Force's controversial "Make or Buy" policy came in for a pretty thorough kicking-around at the recent SAE National Aeronautic Meeting in New York. Occasion was a two-hour panel discussion on the effects of M or B on prime and subcontractors, the Pentagon, and small business.

Present as a panelist was Air Force Colonel I H Larkey, one of the creators of Make or Buy policy, who was the chief target of a barrage of questions from contractors.

"What happens," one contractor wanted to know, "when a weapons system team wins a contract but that team has part of the contract assigned to an outfit that is obviously inferior to its counterpart on one of the losing teams?"

In that case, Colonel Larkey said, the prime is asked to reopen contract negotiations in that particular area. "But," he added, "we generally take the whole team."

Panelist M L Hicks of Convair, asked how his company determines what it will make in its own plant and what it will contract out, said that Convair makes up a formal manufacturing plan before it bids on a contract, a plan that states specifically just what items it will make and what items it will buy. Convair feels that anything to do with making airframes is right down its alley, shouldn't be farmed out.

But specialty work, say, heat treating or the making of electronic components, is contracted out wherever possible.

"We do make major changes from time to time as the contract progresses," Hicks said, "but these changes almost always involve farming out more work, rather than pulling it in."

A representative from GE added, "At GE our policy is to build it outside if at all possible."

The Air Force, incidentally, is practicing what it preaches on Make or Buy, is doing everything possible to put more and more work into the hands of private industry. The Air Force would much rather do research and development work on, for example, numerically controlled machine tool lines (such as the one at Hughes-El Segundo) then let private industry pick up the ideas and put them into actual production.

This means, of course, that the Air Force is going to restrict use of its facilities where they compete with private industry.

And that, as Otto Konigslow Co's L C Leavitt pointed out, will be a big help to small business.

Who gets the procurement dollar?

A GE man let go a loaded, three-barreled question at the panel, "What percentage of total defense business does small business want? What does the Air Force think it should get? And what percentage does small business *actually* get?"

K Weddell of the Air Force's Office of Small Business had the answers. For the last three or four years, small business firms have been getting 26 to 30% of all procurement placed by the Air Force. "Of course, they'd like 100%," he said.

Actually, 20% of the Air Force's procurement dollar goes to small business, but the first tier small subcontractors redistribute 20% of this to second-tier subs. It adds up to 26 to 30% of the overall Air Force procurement dollar.

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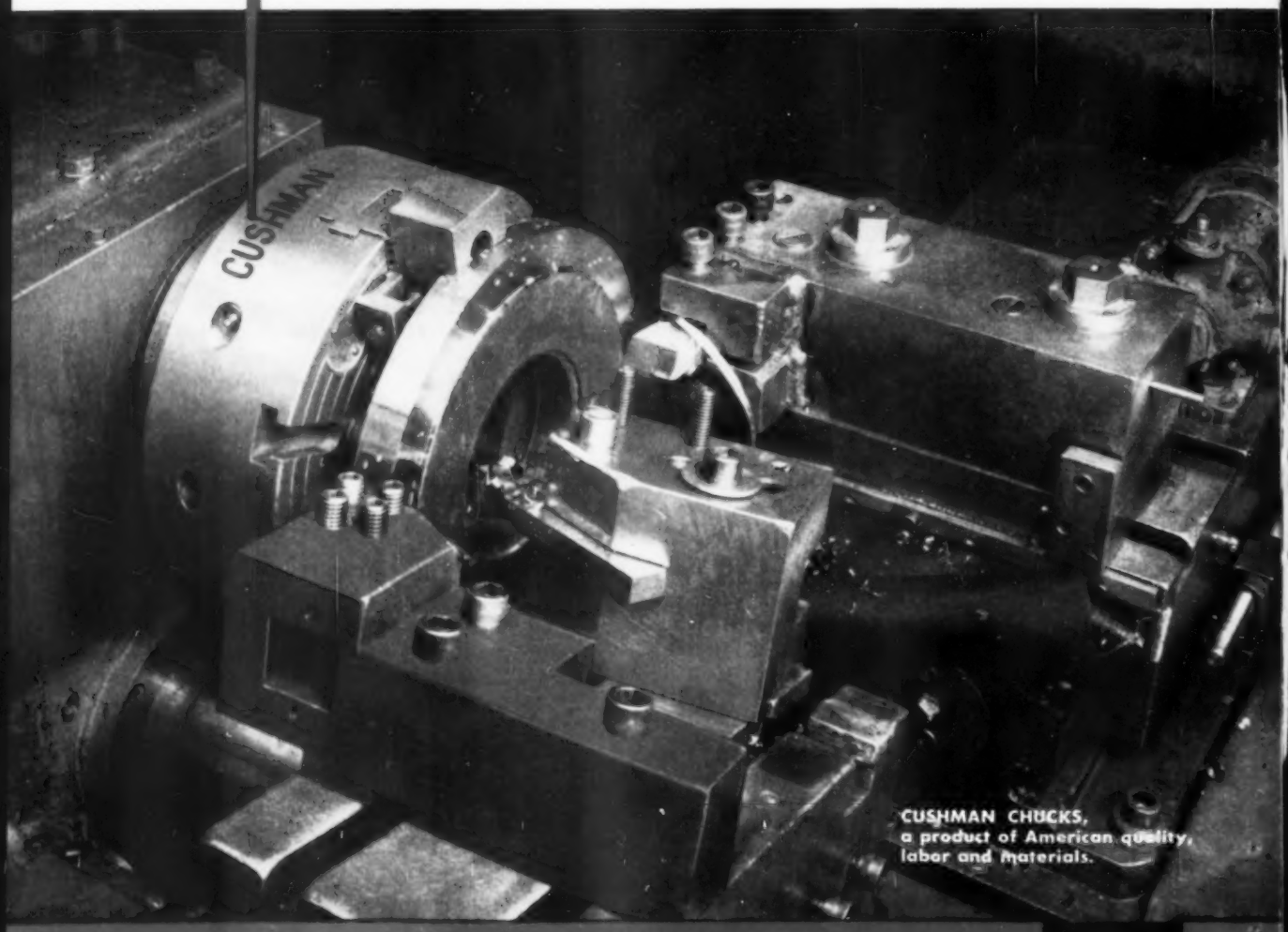

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MACHINE TOOLS...

Orders head up...

Chances are that March net new orders for cutting type machine tools were larger than the February volume, though no official figures were available when this column was written.

One builder reports substantial improvement in March, with April shaping up with further gains. This company, doing better than the average, thinks some of its success is due to the fact that it did not slow down its sales efforts at all during the recession. A second builder says that its sales have picked up and are slowly but steadily heading for higher ground.

Another builder states that first quarter sales are 30% better than the same period a year ago. Still another maker had a big spurt in business in March and is optimistic about April. It believes that improved levels will be maintained all year.

A midwest builder reports March sales up a lot and prospects bright for a "good" first half. But no large orders are included in the bookings.

Builders look to Chrysler...

Several transfer machine builders insist that April's business depends to a big extent on tooling orders from Chrysler for its transmission for 1961 models. Kokomo, Ind, offices of Chrysler are said to have resembled lately a machine tool convention.

Chrysler is expected to spread the orders around as much as possible, with no builder getting a very large slice.

One transfer machine builder reports first quarter shipments up 30% over last year. Another builder has boosted its backlog with a substantial order from Detroit Transmission plus smaller orders from other General Motors plants.

Another transfer machine company has taken some rebuilding jobs for Chrysler's small car axle and transmission lines and for Detroit Transmission.

Competitive pressure for all machine tool orders continues to be terrific. Certain buyers of transfer machines in particular are getting as many as 10 quotations, some of them (according to one source) from unqualified bidders.

Sundstrand buys French firm...

Sundstrand Machine Tool Co, Rockford, Ill, has bought the controlling interest in SPMO (Societe Parisienne de Machines-Outils), Courevoie, France, a suburb of Paris. SPMO builds special drilling machines, bed-type millers and production lathes. It has been a Sundstrand licensee for the past five years. It will build Sundstrand machines for sale throughout the world, except for the United States.

SPMO's present management will be retained. It is headed by Emmanuel Pouvreau as director general.

U S builders and EUCOM...

U S builders with plants in Britain are reported to be negotiating for manufacturing facilities inside the European Common Market, if they do not already have them. The outcome in some cases may be a licensing agreement, and in others outright purchase of companies. This trend means that certain American builders will have production capacity both in the United Kingdom and on the Continent.

Cincinnati to expand Dutch plant...

Cincinnati Milling Machine Co has recently greatly enlarged its British factory at Birmingham. It also has announced that it will increase its shop and office (including engineering) facilities at its Netherland's plant at Vlaardingen, thereby enabling it to make additional models of machines, to produce more machines, to enlarge its service to customers, and to meet better the requirements of the Common Market.

Cincinnati-Nederland N V, which is five years old, builds centertype and centerless grinding machines, cutter and tool grinder machines, and milling machines. Western Europe is the main outlet for its machines.

The British as well as U S builders are eying arrangements within the Common Market. Thomas Ryder Ltd, Bolton, England, has licensed Henschel & Sons, Kessel, Germany, to build three sizes of Ryder vertical automatic chucking lathes. Henschel will have selling rights in West and East Germany, Berlin and Austria.

U S-British builders agree...

A prominent U S machine tool builder and an equally important British builder are about to set up a new company in England for the purpose of making and selling certain types of machines bearing the name of the U S builder. The machines will be made in a plant of the British builder. The announcement of this development probably will have been publicized by the time you read this page.

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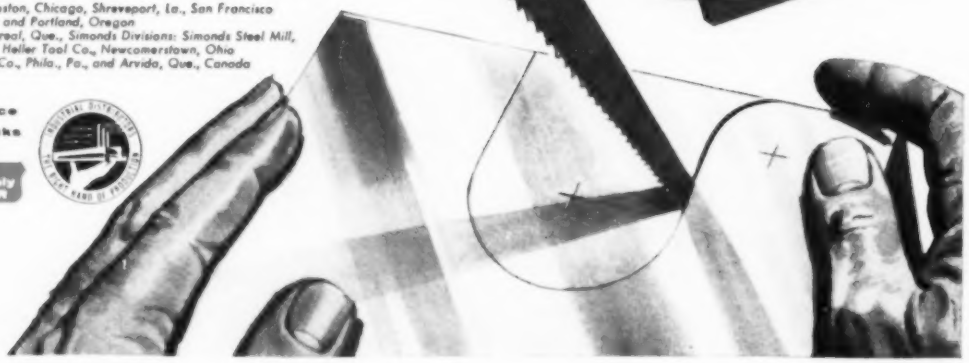


MATERIALS... TRENDS

Extra $ for materials research . . .

$20 million extra funds have been earmarked by the Pentagon for research on materials—most of it to be contracted out during the fiscal year starting July 1. This addition will bring next year's total military materials research program to $90 million, $23 million over current year.

Biggest chunks of the extra fund will be used as follows:

- $6 million to the Army for research on materials used in casings, nozzles, controls, and other parts of solid-propellant rocket motors.
- $2 million to the Air Force to study graphite used in high-quality missile development program.
- $1.5 million to the Air Force for research on "thermal protection" systems—combinations of structural and insulating materials to provide highest strength-weight ratios for structural strength in high-temperature environments.
- $1.5 million to the Navy and Air Force for research on refractory metal alloys.
- $2 million to the Navy and Air Force for research on extruding, welding, casting, forging and similar general manufacturing processes under vacuum and inert-gas environments.
- $1.2 million to the Air Force for research on high-temperature ceramics—adhesives as well as structural materials.

Expensive seeds are planted . . .

$2 million to study graphite! When, in history, has this quantity of money been appropriated in one year to study a material like graphite? What will it accomplish? Where will it lead? Surprisingly, graphite is turning out to be one more of the commonplace materials that has hidden depths. And it takes this kind of money to finance exploration.

Significant in this area is the recent development of *graphite fibers and cloth* discussed by Arthur R Lytle, Vice President, Research, at Union Carbide Corp's Union Carbide Metals Co Div, in a paper describing research on high-strength, extreme-temperature structures at the SAE National Aeronautic Meeting in NY. By processing synthetic organic filaments and cloth through novel graphitizing procedures, a textile has been produced which is 99.9+ % graphite.

Relatively phenomenal tensile strength is retained in this material, as much as 10,000 to 15,000 psi, and it resists bending, folding, creasing, etc. Regardless of whether this new graphite property is used to resist the heat of reaching outer space or to build a more efficient space heater for your home, it is significant because it should now be possible to use graphite as a high-temperature (5000 F) strengthening reinforcement or as a filament. In this form it offers increased electrical and thermal conductivity while improving strength and minimizing failure resulting from shock loading.

A new approach to material research is opened by this development, according to Mr Lytle. Common knowledge of the non-flexible characteristics of graphite offers no basis for expecting graphite yarns and fabrics of normal size and appreciable length to have the strength and flexibility of conventional textiles. Apparently, however, the original form, whether physical or chemical, in which the carbon exists determines the properties of the finally graphitized product.

Inorganic polymers . . .

Currently a speculative project in its earliest stages, because the mechanism whereby polymerization can develop or be forced in many inorganic systems is not now known or recognized, inorganic polymers may become very important new materials. They could, for instance, offer the same challenge as synthetic organic "plastics" now create in a competitive market with metals and natural fibers.

Polymerization has been achieved to a limited extent in some silicon-oxygen and metal-oxygen-carbon linked systems. In other words, metal chelates and PN Cl_2 polymers are known.

Polymerization might provide, in materials not normally capable of structural use, some semblance of the mechanical characteristics of organic plastics. Structurally satisfactory inorganic polymers should offer stability at higher temperatures and possibly, by combination, extend the temperature range of organic plastics in general. The new materials should possess basically different thermal, mechanical, electrical, and optical properties of their own. It could mean, for instance, a transparent material having the strength of steel.

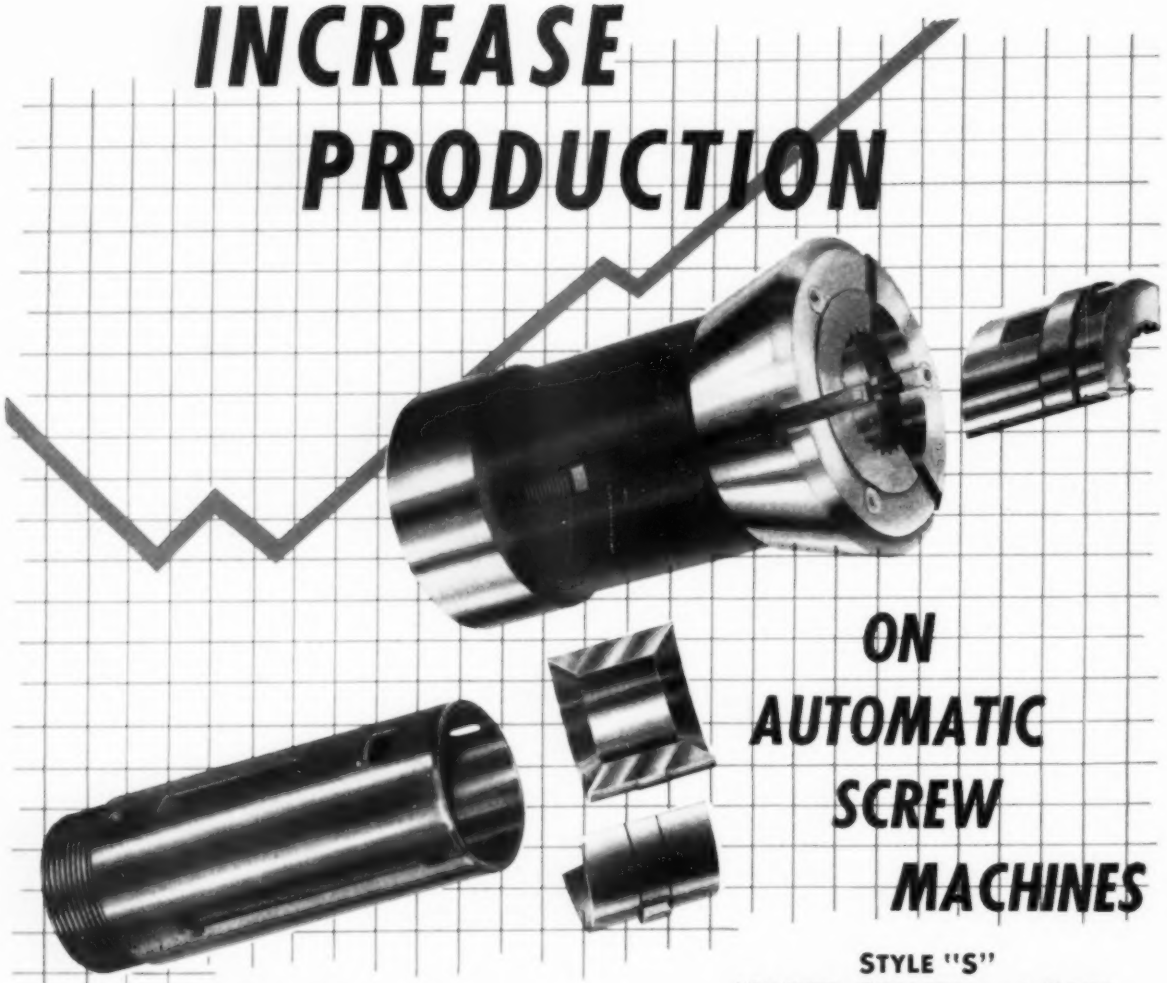
Engineered aluminum forgings . . .

Switchgear parts and connectors for the electrical industry, clamp brackets for outboard motors, architectural hardware, welding-electrode holders, pipe tees and flanges, textile-machine parts, end plates for printing rolls, and clutch parts are among the commercial products of Kaiser Aluminum & Chemical Corp's modernized forging facility at Erie, Penna (p115).

HARDINGE
ELMIRA, N.Y.

MASTERS and PADS

INCREASE PRODUCTION



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WHAT'S AHEAD... in Metalworking

TRENDS

The base is firming up...

Week by week metalworking production is getting onto a more solid base for continuation of operations at or above present levels.

Output already has regained much of the ground lost during the recession. It is a reasonable expectation that further advances will occur in the months ahead.

While the steel boom continues, steel people are of the opinion that not as much of the tonnage going to users is a hedge against a strike as they earlier had thought. Customers are chewing up currently substantial tonnages.

The betterment in so-called durable consumer goods, such as autos and appliances, is helpful to sustain metalworking output. But along with it is a real strengthening in orders for capital goods of various kinds. The demand for capital equipment promises to broaden and that will affect favorably the outlook for expanded production.

Steel warehouses have posted an overall gain of about 25% in business volume this quarter over first quarter 1958, but this varies widely according to product and area.

Chicago and Midwest steel sales are booming, are running 40% ahead of last year. Cleveland is 25% ahead of comparable 1958, the East Coast 20%, and the South and West Coast 10% each. Sheet is still the hot item with warehouses as well as mills, with structurals lagging behind in demand.

Materials handling equipment manufacturers report that while things are looking up from a very low recession level, orders still don't "have much zip to them yet." Fork truck makers say inquiries have picked up considerably and orders are about 25% better than this time last year, but buyers are still hesitant.

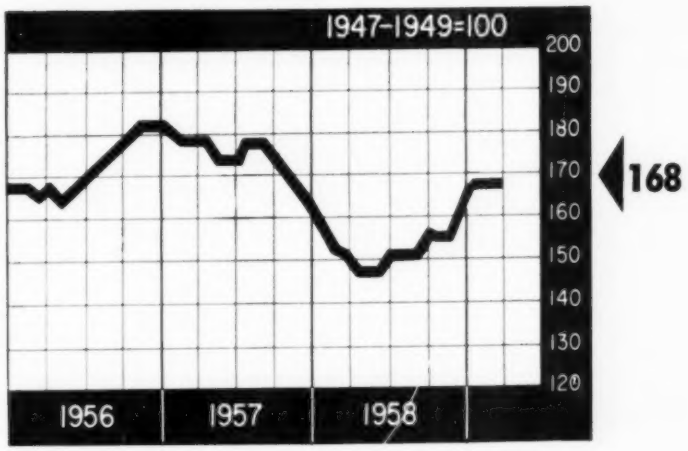
This holds true of conveyor equipment sales, too. Manufacturers report plenty of inquiries but too few orders to build up any kind of backlog. There is quite a bit of price dickering in this highly competitive field, and customers are tending to repair existing systems rather than buy new ones—at least until they're further along on the road to recovery.

Electronics manufacture is booming, particularly on the West Coast, where companies report sales increases of anywhere from 10% to 50% over this time last year. Breakdown on contracts is about 60% military, 40% commercial.

Gray iron foundry bookings have gone up steadily since the first of the year. In January the industry was operating at 72.7% of maximum demand, compared with 67.1% in December, and further gains have been made in February and March. Improvements in the machine tool industry have helped boost sales.

Steel foundry bookings are now running at 61.5% of maximum demand—a sharp increase over the 48.9% figure posted in February. This is the first time in 21 months that the rate has been above the 60% mark (70% is considered fairly good, and at 80% the industry is in clover).

The pattern indicates a continued improvement through the rest of the year and peak bookings early next year, followed by a leveling-off at a substantial operating level.



AMERICAN MACHINIST INDEX OF METALWORKING PRODUCTION

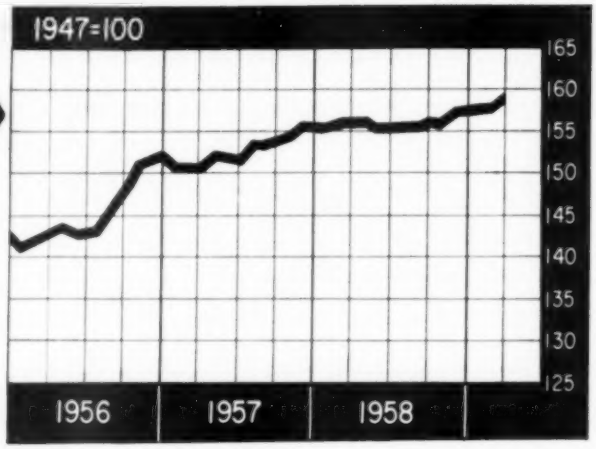
BASED ON MANHOURS WORKED IN THE FIVE COMPONENTS

	MAR Estimated	FEB Preliminary	JAN Revised	FEB Year Ago
Total Index	**168**	**166**	**166**	**153**
Machinery	135	131	131	128
Electrical Machinery	197	199	199	177
Autos	128	135	135	104
Other Transportation	329	325	325	324
Other Metalworking	145	143	143	130

TRENDS WHAT'S AHEAD... in Business

AMERICAN MACHINIST INDEX OF METALWORKING PRICES

	MAR Estimated	FEB Preliminary	JAN Revised	FEB Year Ago
Total Index	**158.6**	**158.4**	**158.2**	**156.0**
Metalworking Machinery	182.6	182.4	182.5	
Other Machinery exc. Electrical	169.9	169.3	166.2	
Electrical Machinery	158.9	158.9	157.5	
Fabricated Metal Products	148.7	148.6	146.6	



Rising employment joins the parade...

A drop in the number of unemployed is the latest in a series of developments making for a bright business outlook. Latest reports by the Department of Labor show a drop of 300,000 in the number of jobless during March.

Seasonal factors were only partly responsible for the upturn in the number of jobs, and the picture should continue to brighten.

Average weekly hours of work have been rising in recent weeks, and employees in manufacturing are now working about as many hours per week as they did before the recession.

Overtime work is also on the increase, and by the same token slack time is disappearing. Any further increases in output will probably lead to rehiring of employees laid off during the business slump. This rehiring process should help dry up remaining unemployment pools.

The brightening employment outlook is already having effects that are likely to harden the foundations of a new business upswing. Results of growing optimism have already showed up in the consumer outlook. Federal Reserve Board reports indicate consumers believe business will have a good year—and consumer feelings about business play a big part in determining their buying plans.

Another important factor to keep in mind is that consumer spending in general has been rising at an annual rate of $1 billion a month, without any big increase in installment buying.

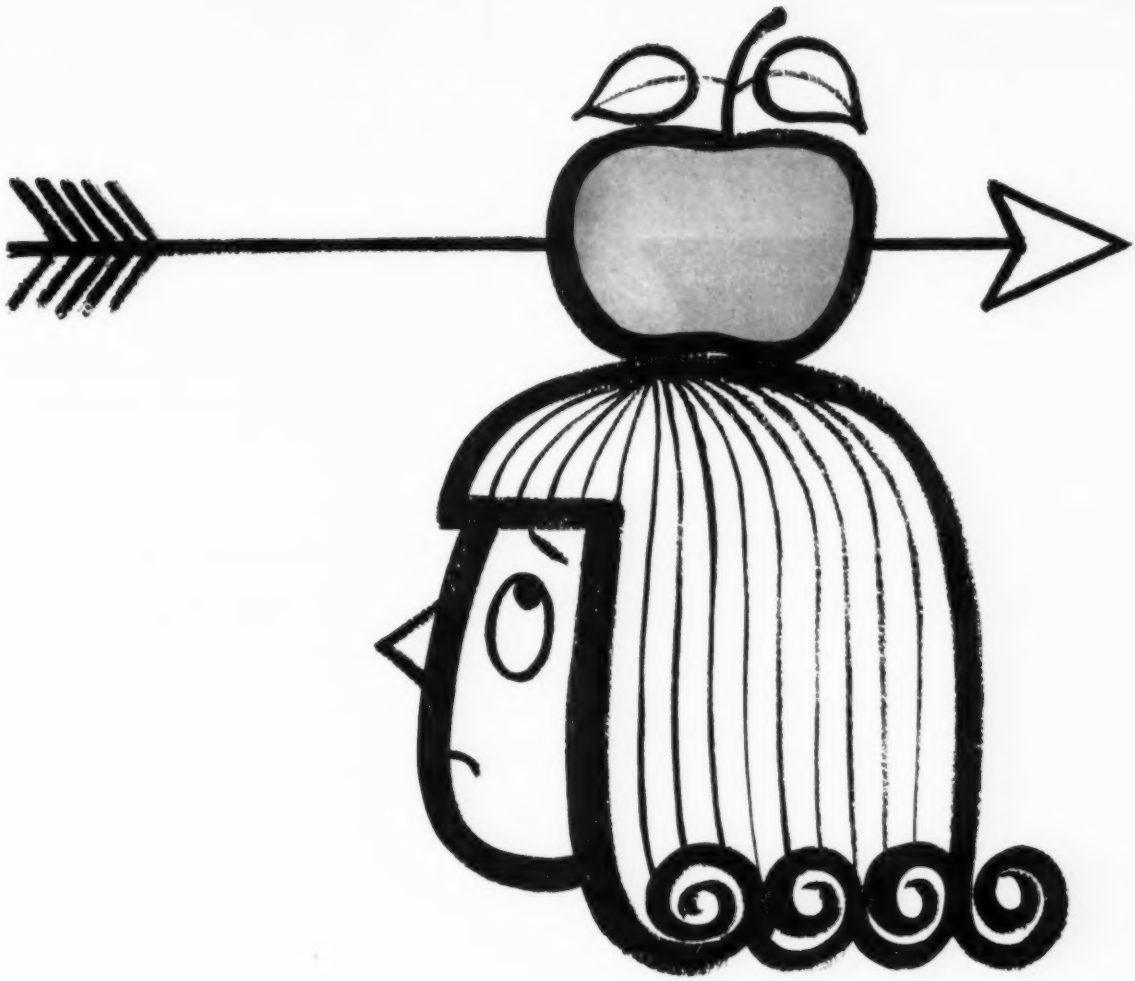
As workers begin to feel secure in their jobs, they will also feel less wary about buying on credit. And when they do turn to credit buying, they will be looking for new products.

There is thus a lot of grass roots support for the recent upturn in capital spending. This continued strength of consumer buying coupled with growing capital expenditure makes for a healthy general business outlook.

WEEKLY BUSINESS INDICATORS	Latest Week	Preceding Week	Year Ago
Business Week Index of Activity (1947-49=100)*	150.2	149.9	122.5
Steel ingot production (thousand tons)	2,638	2,638	1,308
Electric power output (million Kilowatt hours)	12,618	12,709	11,326
Production of automobiles and trucks	169,246	155,171	87,780
Engineering construction awards (Eng. News-Record, millions)	$469.5	$338.2	$354.6

MONTHLY BUSINESS INDICATORS	Latest Month	Preceding Month	Year Ago
Refrigerators sales (thousands of units)	256	287	206
Vacuum cleaners sales (thousands of units)	243	370	265
Washers sales (thousands of units)	288	331	238
Household electric ranges sales (thousands of units)	79	84	79
Radio production (thousands of units)	1,125	1,526	1,027
Television production (thousands of units)	437	415	434
Gear sales index (1947-49=100)	218.6	145.5	175.3
Foundry equipment new orders index (shipments, 1947-49=100)	127.4	137.0	57.9

* Seasonally adjusted



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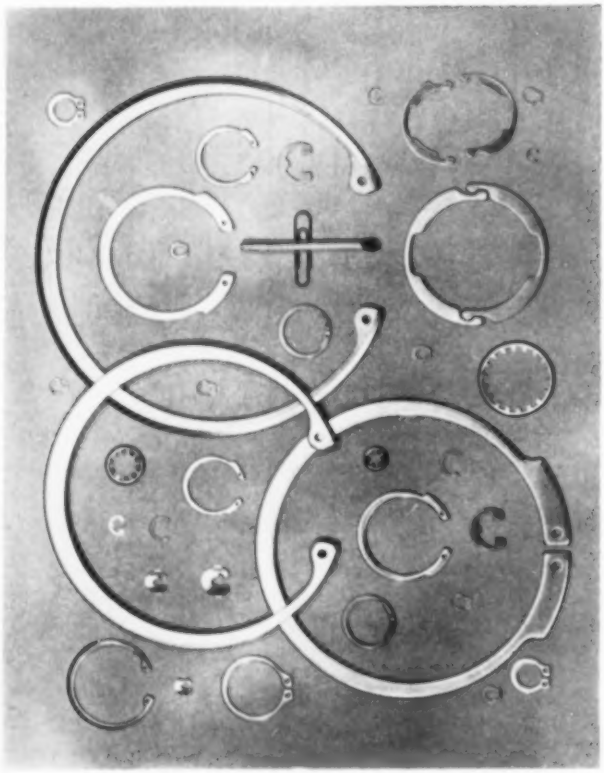
By taking advantage of the ultra-high strength, spring properties, good corrosion resistance and high temperature properties of this unique metal, they now produce retaining rings with performance characteristics heretofore unobtainable at reasonable cost. Their new PH 15-7 Mo rings have the necessary combination of strength and durability for economical service in chemical, food and beverage machinery; aircraft and missile components; units for nuclear

How Armco PH 15-7 Mo Stainless Steel Helped make a good product better



reactors, appliances; marine equipment; and other applications subject to severe service conditions.

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American Machinist
MAGAZINE OF METALWORKING PRODUCTION • ESTABLISHED 1877

Into a Whirl, If Not Into Orbit

Seven military test pilots have been selected to undergo training as the nation's first astronauts. One of these men eventually will be picked to ride the first U S manned satellite into orbit around the earth.

These men are to have the science-fiction name of Mercury Astronauts, because Project Mercury is the appellation chosen for this man-in-space venture. It is a safe bet that it won't be long before every American city, town and village will have its full quota of junior astronauts, who will be imagining themselves riding in orbit 100 miles above the earth.

Sounds fascinating . . .

doesn't it? But just as glamorous in its own way is what's happening to put metalworking techniques into a whirl, if not into orbit. And most of it has to do with aircraft, missiles and astronautics.

New and strange terms are popping up all around. We hear about "high-energy rate forming" and about "roll extrusion" and about "explosive forming." "Electric blanket brazing" is a new process hardly more than out of the developmental stage. And many of the new techniques with unfamiliar names are being devised through sheer necessity to solve difficult problems in manufacturing so-called "hot planes."

Despite opinions to the contrary . . .

some plane production men have expressed the conviction that the "high-energy rate" philosophy should be applied to machining; and when it is, it will revolutionize things. Because of the tremendous cost of high-alloy materials needed in air and space vehicles, the manufacture of chips is being eliminated as much as possible. Thus costly machining time is being cut down and expensive materials conserved.

What's happening currently is merely a curtain-raiser to what is coming. Much production equipment required to make aircraft and missiles is not yet even designed. Lathes with much greater swing and travel, for one thing, must be built. And other conventional machines will have to be increased in size. Along with being bigger, these machines will have to possess much greater rigidity.

The new materials—ceramics, plastics, heat-resistant steels—will tax the ingenuity of production men not only in forming and machining methods, but also in the extremely close tolerances demanded. Accuracy in missile work is especially critical and necessitates tolerances unheard of in aircraft production.

Electrical discharge machining . . .

is being thought of in terms of making large, complex forging dies. High interest is being generated in machine tools capable of simultaneous multiple-end turning, boring and drilling certain large components.

Radical changes in metalworking production techniques thus are coming swiftly, mainly because ways must be found for solving the unsolvable. These new processes will edge or shove out the old. It is just a matter of time.

So whatever part of Metalworking you may be in, keep your eye on what is taking place in the aircraft, missiles and space vehicle industries. For the sake of your own future, you cannot afford to ignore this fascinating, ever-changing parade of new developments.

Burnham Finney EDITOR

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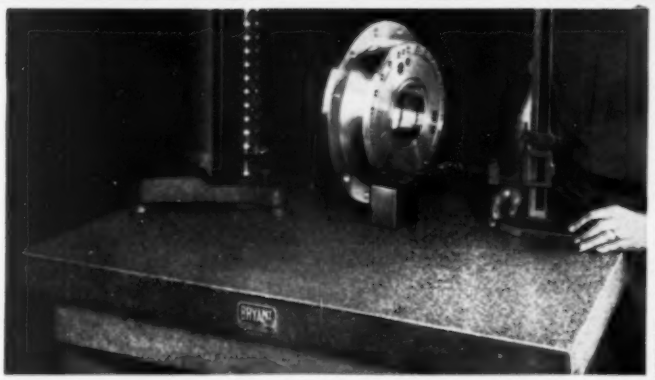

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59-B-12

Let's destroy some MYTHS about SKIN DISEASE

By Anderson Ashburn, managing editor

Skin irritations that require medical attention are a major problem in industry. Estimates vary, but generally place them at 50 to 75% of all compensation cases. A considerable folklore has grown up around this situation.

Among the myths may be cited the belief that cutting oil causes most cases of dermatitis, that hot weather makes it worse, that any case of skin disease is the result of on-the-job exposure.

A recent study by the Industrial Hygiene Foundation of America, Inc, aimed at getting a truer picture, indicates:

- About 9 out of every 1000 persons in the manufacturing industries are likely to have industrial dermatitis each year.
- About 3 of these will be due to petroleum products.
- If the rates are figured for production workers alone 12 out of every 1000 will be affected and 5 of the 12 will be due to oils and greases.

IHF makes a pilot study

The basis of these conclusions is a pilot study made by IHF, operating under a grant from the American Petroleum Institute. The complete report has been published in the American Medical Association's Archives of Industrial Health, Vol 17, pp 259-272.

Some sources have placed dermatitis as high as 70% of all industrial diseases, others have cited it as relatively infrequent with an incidence of about 1%. These examples of entirely different approaches to the problem are typical of the confusion that has existed and the need for an impartial study.

The IHF study was based on 36

PREVENT ADVERSE SKIN EFFECTS

DO

WORK GARMENTS SHOULD BE WASHED with reasonable frequency — not less than once a week.

IF A PROTECTIVE HAND CREAM IS USED, apply before starting work and after each periodic washing.

WHEN HALTING WORK TO EAT or at end of work shift, cleanse hands and arms thoroughly with mild soap and warm water using soft brush when needed.

REPORT TO YOUR FOREMAN at first sign of skin irritation. Get treatment promptly for all cuts and scratches.

DO NOT

DO NOT WEAR CLOTHING THAT HAS BECOME SOAKED with cutting fluid.

DO NOT CONTAMINATE CUTTING FLUID by spitting into oil pan or drain.

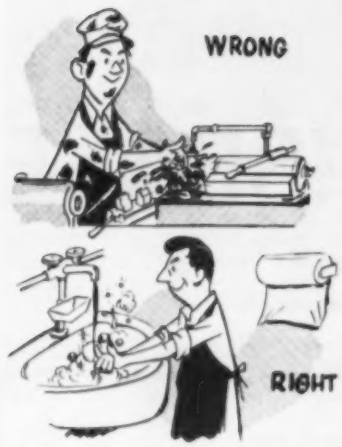
DO NOT USE ANOTHER EMPLOYEE'S TOWEL, wipe cloth or brush. Maintain clean ones for your personal use.

DO NOT WIPE HANDS OR ARMS WITH WASTE as the skin may be scratched by metal particles in the waste or on the skin.

GASOLINE, KEROSINE, NAPHTHA, turpentine and similar solvents MUST NOT BE USED for removal of oil or grease from the skin.

Prepared for
Users of Petroleum Products by
INDUSTRIAL HYGIENE FOUNDATION OF AMERICA, INC.

Wall card carries advice . . . of Industrial Hygiene Foundation to workers, will soon be available from almost any oil company



The right way and the wrong way to wash at quitting time

HERE ARE 12 RULES TO FOLLOW IF YOU

1. Work garments should be washed with reasonable frequency. Workmen should put on clean working clothes weekly, more frequently if necessary. Splash guards fastened to cutting machines and the wearing of impervious armlets have been found effective in affording protection from flying chips and oil spray. Such guards should be made of oil-proof material and should not be permitted to become dirty, loose, or ragged.

2. Before starting work, at lunch time, and when quitting work wash with mild soap and warm water, generously used. Difficult-to-remove dirt should be loosened with a soft brush. Do not use soaps that contain harsh abrasives. They may increase the chance of skin irritation. If a protective hand cream is used, apply it before starting work and after each periodic washing.

3. Gasoline, kerosene, naphtha, turpentine, and similar solvents must not be used for the removal of oil or grease from the skin. Such solvents defat the skin and may thus cause dermatitis or aggravate existing skin disease.

4. Do not use another employee's towels or wipe cloths. Each employee's personal wiping material should be washed frequently.

5. Employees should be particularly careful to protect their clothing from becoming soaked with cutting fluid.

6. The filthy practice of spitting into oil pans or drains should be absolutely prohibited. Discharges from the mouth and throat always contain bacteria which will contaminate the cutting fluids. If necessary, cuspidors should be provided for the machine operators.

7. Every cut and scratch should receive medical attention. It may be the beginning of a troublesome infection and the worker should be sent to the First Aid Room or to the plant physician for treatment.

8. Since most machine tool plants reclaim their oil, the constant removal of the metallic particles from the cutting fluid is necessary to avoid injury to the skin. Ordinary filtration and centrifuging machines are not always able to remove the minute metallic

plants with 103,586 employees, chosen to give a suitable statistical base. Careful attention was given to finding and reporting the cause of each case of industrial dermatitis. Unfortunately, not all the plants gave complete reports on non-occupational cases. In three plants, no off-the-job cases were reported, while in one plant 19 out of 20 cases were non-occupational.

The study covered the first half of the year and found no seasonal variation in the incidence of cases reported. In fact, the number of cases was higher in February and March than it was in May and June. However, some data collected from other sources indicates a slight seasonal peak in July and August.

Women production workers had an incidence of dermatitis about twice that of men.

Age was not reported in this study, but previous data have indicated a higher rate among young workers.

In view of the common feeling that many cases of dermatitis result from cutting oil (the Foundation found that published reports ranged from 0.5% to 43%), special care was taken to track down the cause of each case. Among production workers the incidence of cutting-oil dermatitis was 0.32%.

On the basis of this study, the Foundation estimates that with 16,000,000 employees in the manufacturing industries, there are 128,000 occupational dermatitis cases each year and about 60,000 would be due to petroleum products. Of these, 41,000 could be traced to cutting compounds.

Does cutting oil cause dermatitis?

In seeking the answer to this question, the writer has reviewed the impressive collection of data, opinions, and claims assembled by the Hygiene Panel of API for the IHF study.

As the Department of Labor points out in a pamphlet, "Almost every substance that can cling to the skin may produce dermatitis if left on the skin long enough, even water."

Straight mineral oils are generally free from bacteria as produced and non-soluble cutting oils are unfavorable for the growth of bacteria. Trouble with these oils can generally be traced to lack of cleanliness on the part of the worker and to bacteria normally present on the skin.

But when you start putting additives into oil, it is a different story.

All soluble oils contain emulsifiers, and may contain coupling agents and other additives. In addition, the user may add his own inhibitors and germicides to the oil. Additives are not limited to soluble oils, of course, with a wide variety of activators added to the non-soluble oils.

These additives may vary from harmless to toxic, but in combination with one another, you soon reach a point where no one can be sure what new compounds the mixture contains.

As soon as the oil is used it is likely to accumulate metal slivers. Even if the oil is adequately filtered, a careless workman may wipe his hands on dirty waste that contains such slivers. Minute abrasions caused by these slivers admit bacteria from the surface of the skin.

It is well known that bacteria can grow in many types of soluble cutting oils containing additives par-

WANT TO AVOID DERMATITIS IN YOUR PLANT

fragments which may harm the skin. Where centrifuge or filter equipment is not available, heating will reduce the viscosity sufficiently to allow the metal to settle to the bottom of the container. The frequency of reclaiming the oil may vary in different plants or with different conditions. Certainly these metal chips should not be permitted to accumulate in the oil.

9. Used cutting oils may be sterilized by heating. However, the practicality of this method depends to some extent on the ability of the particular oil to withstand prolonged heating without serious deterioration. Sterilization temperatures range from 140°F to 180°F and the interval required varies from 30 to 60 minutes, the longer time being for the lower temperature.

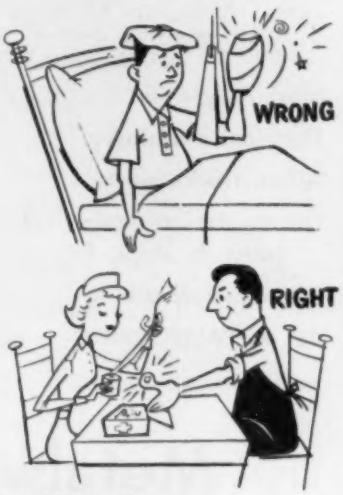
10. In the further interests of good housekeeping, it is suggested that a regular schedule of cleaning be set up for machines on which cutting fluids are used, and all sediments and deposits of old lubricants removed. Where oil is likely to accumulate on the floors, it may be advisable to provide floor boards or cat-walks to prevent the worker's feet from coming into prolonged contact with the oil.

11. Posters, placards, and warnings stressing the importance and details of good skin hygiene are helpful when judiciously displayed about the plant in strategic areas and washrooms. They should complement, not replace, direct supervision.

12. The human respiratory system is easily irritated. Therefore, avoid breathing the vapor or spray from any oil or solvent even for a short time.

A NOTE ABOUT DERMATITIS CONTROL

These 12 rules are from the manual "Good Plant Practice for Workers Using Petroleum Products," prepared by the Industrial Hygiene Foundation of America Inc. Copies should soon be available from most suppliers of cutting oils.



Possible results of right and wrong attention to skin abrasion

ticularly when water has been added. Periodic sterilizing of the oil by heat is not a popular solution to the problem for most plants. Hence the desire for a suitable germicide.

The original germicides were usually based on phenol. Excessive concentrations of phenol (carbolic acid) are likely to irritate the skin. Phenol is also charged with causing corrosion of machine parts and interfering with the lubricating properties of the oils.

This has tended to make oil companies cautious about germicides, though recent developments have produced germicides that are claimed to be free of the objectionable properties of phenol.

Key to prevention

There is a growing body of evidence that reliable germicides in the proper concentration will inhibit the growth of bacteria without hazards, though in concentrated form they may produce chemical burns.

Clean cutting oil alone will not solve the problem. There will be ample bacteria on the average pair of hands to cause trouble if the worker fails to exercise proper personal hygiene.

IHF's 12-point program

The 12-point program proposed by IHF is a summary of the measures that have proved effective in the past. Implementing the program is basically a personnel problem. "It has been suggested," says the IHF manual on plant practice, "that it would be wise to stress impersonally at the time the worker is hired that he is paid for two duties: (1) to operate the machine according to instructions, and (2) to wash thoroughly according to instructions before and after the operation."

The program must be pursued under the close but tactful supervision of a responsible person. "Employees should not be left to their own devices, because cleaning will be neither consistently nor thoroughly done."

Clean the worker, too

While the most immediate gains can be made by cleaning the worker instead of the oil, there remains a responsibility for management to be informed on the toxic content, if any, of the oils used and of the compounds added to the oils in the plant.

Unless the employer supplies wash basins, hot water, suitable skin cleansers, and towels, he cannot expect to get results from a drive on personal cleanliness.

Keep the oil clean

Finally, keep the cutting oils as clean as possible. Do this first by thorough cleaning of machines on regular schedules to eliminate breeding grounds of bacteria, and by eliminating oil leaks that permit lubricating oil to mix with cutting oil. Secondly, keep bacteria from accumulating in the oil by sterilizing the oil with heat, at regular intervals, by changing the oil, or by adding a reliable germicide.

With these preventive measures, backed by careful medical attention to all cuts and scratches, you won't eliminate dermatitis completely. But you can be sure that most of the cases will have been contracted at home and not at work.

HERE ARE METALWORKING'S CAPITAL SPENDING PLANS

(Millions of dollars)

	1958 (Actual)	1959 (Planned)	1958-59 % change	Preliminary plans 1960	1961	1962
Machinery	$915	$986	+ 8	$1036	$1044	$1068
Electrical machinery	459	532	+16	591	532	532
Autos, trucks, parts	558	709	+27	730	679	740
Transportation equipment (aircraft, ships, RR)	370	440	+19	343	326	326
Other metalworking	723	875	+21	941	908	838
ALL METALWORKING	3025	3542	+15	3651	3489	3494

Metalworking holds the spotlight

America's metalworking firms are going to spend almost 15% more for new plant and equipment this year than last—$3.542 billion as against $3.025 billion, putting a solid floor under an expected rise of the U S economy to new highs in the next year or two.

Not only that, U S business as a whole plans to increase its capital spending by 7% over 1958 before the year is out—from 1958's $32.091 billion to $34.209 billion.

And even more significant: the metalworking industries plan to spend more (3%) next year on capital goods than they are in 1959, according to preliminary plans of companies just surveyed by the McGraw-Hill Department of Economics. Overall business at the same time will increase its spending about 1%. This is particularly noteworthy because the McGraw-Hill survey has traditionally shown that the farther plans are in the future the more they are inclined to be on the low side—especially in the case of smaller companies, which tend more toward hand-to-mouth capital spending than the larger ones.

Particularly noteworthy among the five major segments of metalworking is the intention of the automotive industry (autos, trucks and parts) to spend 27% more this year on new plant and equipment ($709 million vs $558 million) than last—reversing a downtrend since that industry's sales and production began to decline in 1956. Next year, according to preliminary plans, the automotive industry will increase its capital spending still more (about 10%), will taper off slightly in 1961, then again increase its outlays for new plant and equipment in 1962.

"Other metalworking" firms anticipate metalworking's second largest (after autos) capital spending boost this year—a 21% rise from 1958's $723 million to $875 million. In 1960 these industries expect to up their outlays another 7%, in 1961 to cut back about 4% (but these are traditionally low preliminary estimates, remember), and to decrease spending again, by about 7% in 1962.

The transportation equipment industry (aircraft, ships and railroads) will increase its spending 19% this year ($370 million to $440 million) over 1958. But in 1960, preliminary plans indicate this industry will cut its spending back about 12%, then cut back another 4% or so in 1961, and hold that figure in 1962.

Electrical machinery manufacturers plan to up their spending on new plant and equipment 16% this year over 1958 ($532 million vs $459 million). In 1960, they plan to spend still another 10%, in 1961 will cut their spending 10% back to 1959 levels and hold to that figure through 1962. But here again such far-advanced plans are usually on the low side.

Machinery makers themselves plan the smallest capital spending increase of any of the five metalworking categories—up 8% this year over 1958 ($986 million against $915 million). But 1960 will see another jump of 5%, 1961 and 1962 more slight increases.

Thus metalworking as a whole will show a 15% increase in capital spending this year over 1958, 3% more next year, a 4% drop from 1960 in 1961, and will stay about that level in 1962. But again, these are historically low two-or-three-years-ahead estimates.

Better sales this year

The metalworking industries this year expect to do anywhere from 2% (transportation equipment) to 19% (autos, trucks and parts) more business this year than last. The others: machinery 9%, electrical machinery 8%, and "other metalworking" 5%. And without exception they expect sales to take a tremendous jump in the 1959-1962 period.

Keeping pace with an expected fast rise in plant and equipment outlays and sales over the next four years will be mushrooming expenditures for research and development.

It is interesting to note, according to the McGraw-Hill survey, that manufacturing industries will spend more money on modernization than on expansion from here on out through 1962. This year, for instance, the machinery manufacturing industry will devote 68% of its capital goods outlay to replacement and modernization, only 32% to expansion. The figures for this industry from 1960 through 1962 are 75% for modernization, 25% for expansion.

. . . AND HERE'S WHAT ALL BUSINESS WILL SPEND

	1958 (Actual)	1959 (Planned)	1958-59 % change	Preliminary plans 1960	1961	1962
ALL MANUFACTURING	$9761	$10,742	+ 7%	$10,448	$10,265	$10,444
Petroleum	4819	5338	+11	5363	5441	5609
Mining	394	409	+ 4	342	286	271
Railroads	754	777	+ 3	816	800	864
Other transportation and communications	3899	4195	+ 8	4381	4346	4363
Electric, gas utilities	6088	6182	+ 2	5974	5723	5952
Commercial	7041	7534	+ 7	7609	6772	6095
ALL BUSINESS	32,091	34,209	+ 7	34,263	32,883	32,833

as capital spending outlook brightens

...and total U S investment in new plant and equipment will be even greater in 1960

Electrical machinery manufacturers will spend in 1959 58% for modernization, 42% for expansion—in 1960-1962 59% for modernization and 41% for expansion.

Automotive industry, already overexpanded from the boom days of 1955, will devote only 10% of its money to expansion this year, the rest to modernization. For the 1960-62 period, the ratio will be 84% to 16% in favor of modernization.

Transportation equipment industry (aircraft, ships, railroad equipment) will have a 66% to 34% ratio this year, and a 70% to 30% ratio in the years 1960-1962.

"Other metalworking" industries are spending 63% of their capital goods money on replacement and modernization this year, in the 1960-1962 period will spend 65% of their outlay on modernization.

All manufacturing industries combined are devoting 65% of their outlay to modernization in 1959, and the same in 1960-1962.

Summing up: capital goods spending is beginning what appears to be a long, steady upward climb after a prolonged period of recession. Emphasis will be on modernization and replacement, rather than on expansion. Sales by user industries will keep pace with modernization over the next four years, and increasing outlays for research and development promise that the years after that will be ones of steady growth as the results of research reach the production stage in the form of new products and processes.

BREAKDOWN OF BUSINESS' SPENDING PLANS

INDUSTRY	1958 Actual	1959 Planned	1958-1959 % change	Preliminary Plans 1960	1961	1962
Iron & Steel	$1,217	1180	— 3	$1,274	$1,032	1032
Nonferrous Metals	510	428	—16	368	383	394
ALL METALWORKING	3025	3542	+15	3651	3489	3494
Machinery	915	986	+ 8	1036	1044	1068
Electrical machinery	459	532	+16	591	532	532
Autos, trucks, and parts	558	709	+27	730	679	740
Transportation equipment	370	440	+19	343	326	326
Other metalworking	723	875	+21	941	908	838
Chemicals	1320	1386	+ 5	1441	1542	1635
Paper & Pulp	578	636	+10	617	611	587
Rubber	134	165	+23	188	203	223
Stone, Clay & Glass	399	498	+25	469	478	486
Petroleum Refining	665	698	+ 5	670	750	765
Food & Beverages	742	783	+ 6	719	702	692
Beverages	176	170	— 3	145	124	133
Food	566	613	+ 8	574	578	559
Textiles	288	321	+11	324	326	342
Miscellaneous Manufacturing	883	835	— 5	737	749	784
ALL MANUFACTURING	9761	10,472	+ 7	10,448	10,265	10,444
Petroleum industry	4819	5338	+11	5363	5441	5609
Mining	394	409	+ 4	342	286	271
Railroads	754	777	+ 3	816	800	864
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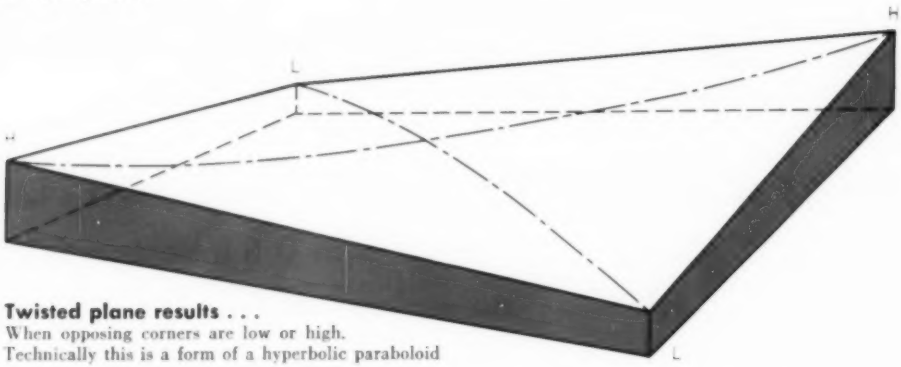
Classic Whitworth method . . .
spots three plates against each other in alternate pairs. After No. 2 and 3 have been worked together, the contact will approach a straight line

Whitworth was only partly right

By R J Rahn, research engineer,
Rahn Granite Surface Plate Co, Dayton, O



Twisted plane results . . .
When opposing corners are low or high.
Technically this is a form of a hyperbolic paraboloid

Sir Joseph Whitworth's three-plate matching system has been a classic method for producing flat surfaces for 119 years; yet it is incomplete. In 1840 the toolmaking art was not advanced enough to see the error, but now we can see how this established method, if followed literally, might easily produce sections of spirals instead of flats.

The Whitworth system has been almost universally accepted without question to this day. A search of the Library of Congress unearthed 34 articles and books that mention Whitworth's presentation before the British Association for the Advancement of Science in 1840, one reference being dated as late as 1953 (*AM*—Aug 3 '53, p105).

The method, as described in Whitworth's own words, works this way:

"Let one of the plates now be selected as the model, and the others be surfaced to it with the aid of coloring matter. For distinctness they may be called No. 1, 2, and 3. When No. 2 and 3 have been brought up to (made as nearly flat as) No. 1, compare them together. It is evident that if No. 1 be in any degree out of truth, No. 2 and 3 will be alike, and the nature of their error will become sensible on comparing them together by the intervention of color. To bring them to a true plane, equal quantities must be taken in both from corresponding places. When this has been done with all the skill the mechanic may possess, and No. 2 and 3 are found to agree, the next step is to get up No. 1 to both, applying it to them in immediate succession, so as to compare the impressions. The art here lies in getting No. 1 between the two, which is the probable direction of the true plane. It is to be presumed that No. 1 is now nearer truth than either of the others, and it is therefore to be again taken as the model, and the operation repeated."

What's wrong

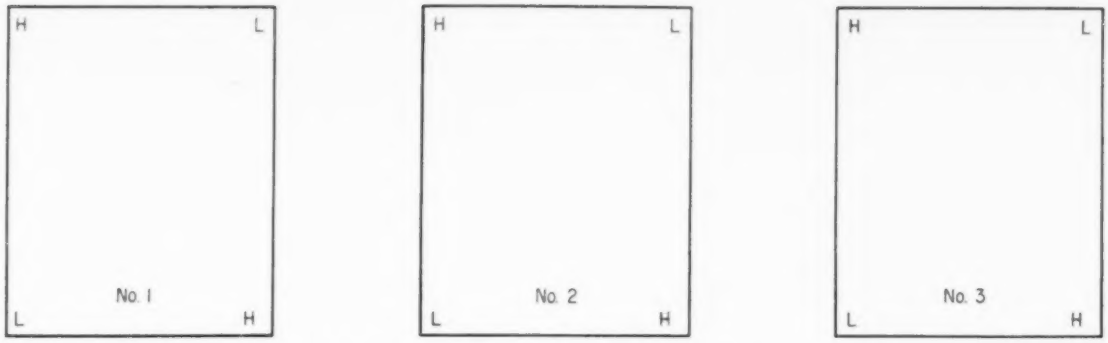
This theory has been tested in exaggregated form, just as any new theory is tested for fallacies. Three oblong pieces of wood were worked into a twist by filing down two opposite corners on each about 1/16 in. Then the Whitworth method was approximated by spotting the surfaces with carbon paper and sandpapering the spots that showed contact. When each piece showed fairly good contact with the other two, the result was not three planes, but three twisted planes.

We called these blocks "wobble planes," because they really wobble on a flat surface. All are alike. Any one can be turned over and placed on another so corners marked H (for high) on one plate will contact corners marked L (for low) on the other. Plates can be turned end for end without changing the situation.

But where did Sir Joseph err? Any cross-sections parallel to an end or side show straight lines. But sections taken across the diagonals clearly show the error. A section along any diagonal HH is uniformly concave, and a section along any LL is uniformly convex. Line LL fits line HH perfectly.

Now that the cause of the error is seen, the cure is obvious. One simple addition to Whitworth's method would have resulted in three perfect planes, in spite of the fact that he had no instruments in 1840. Here is our addition:

"After completing the first cycle of spotting and scraping the three plates



Three matching planes . . . will fit together with L corners touching H corners

by the Whitworth method, prepare a partially finished straightedge of length equal to the diagonal. Compare this straightedge to any of the three plates and note which diagonal is convex. Spot and scrape the edge of the straightedge to fit this convex diagonal. Now spot and scrape each of the three plates all over to fit the straightedge. Of course, all three will now become fairly uniformly convex. This does not involve the removal of any excess material, since the low corners so produced will be no lower than the two corners already too low. Next repeat the Whitworth process as originally explained. Again rescrape the straightedge to the convex diagonal. The convex diagonal can be determined by using a spin test. A perfect straightedge will spin at the center on the convex diagonal and pivot at the ends on the concave diagonal. When the plate is uniform (either convex, concave, or straight) and the straightedge is a perfect fit, the straightedge will pivot at a point approximately 1/5 of the length from the opposite end to that being pushed. Now continue, alternating the Whitworth process with the Rahn straightedge technique until each of the three plates completely spots each of the other two, and the straightedge also spots both diagonals of each plate. We can now be sure we have three correct planes."

Better equipment

With 1959 instruments, a much simpler method can be used. A straightedge comparator can be made by mounting a ten-millionths indicator at the center of a bar equal in length to the diagonals of the plates. Small pads can be placed under the ends so the bar will set on any surface. Readings can be taken on the two diagonals of a plate, and the indicator can be adjusted so the readings are equal but opposite in sign. This establishes zero for the plane. Now the corners can be worked down by the most convenient method, and the Whitworth method can be continued.

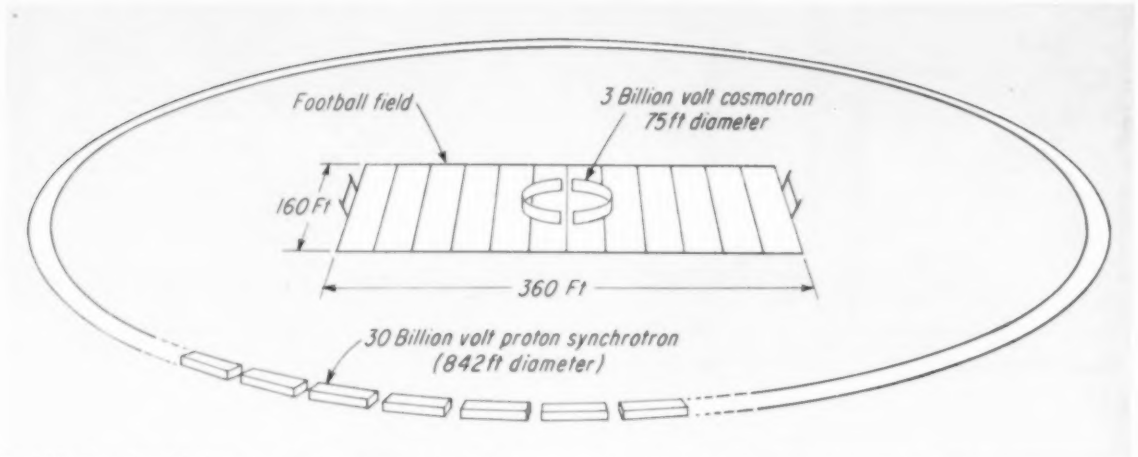
Best modern method . . .
is to check with a ten-millionths indicator. Pads support beam from ends of diagonals

With square plates, the solution is easier. As one plate is matched to another, the process must be repeated with one plate turned 90°. This puts H corners together and L corners together to eliminate the twist effect.

This is a valid objection to Whitworth's system in theory, but does it have any practical value? Consider a 4x8-ft surface that is rough-machined on a planer. Even a good planer may have some twist; and most planers are worn more at the centers of their tables. The deviation may be small as planer tolerances go, but it may be large in terms of plate tolerance. Once the twist is produced, it can never be discovered and removed by following the Whitworth method exactly.

It is ironical that the Whitworth method has been considered perfect during the past 119 years, in which cast-iron surface plates have been standard, and has only been found wanting now that granite surface plates are superseding cast-iron plates. However, many iron plates are still in use, and knowledge of the diagonal comparator test for twist may still be of value.

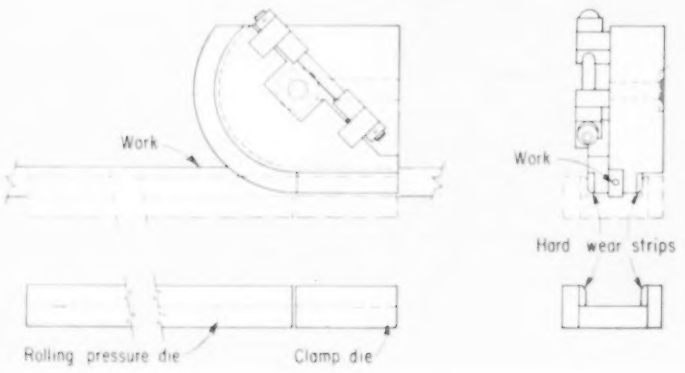
Diagonals will match . . .
because they are curved equally. This error can be caught with a straightedge comparator



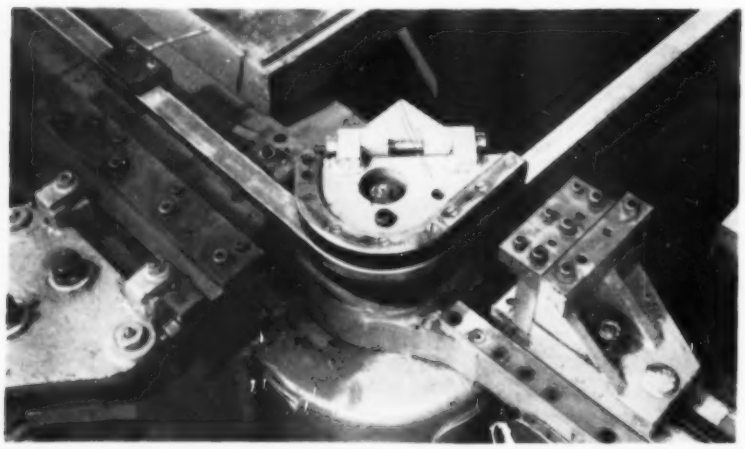
Brookhaven Synchrotron will be larger than a football field and half a mile around the circuit. Guide magnets, for which the copper coils were bent, are spaced around the circumference to control the direction of proton flow

Big copper coils bent

By George W Levally,
electrical engineer
National Electric Coil Co
Div of McGraw-Edison Co
Columbus, Ohio



Lapover clamp die held two horizontally split bending-form sections together—and hardened wear strips kept spacing accurate. Draw bend was made without wiper

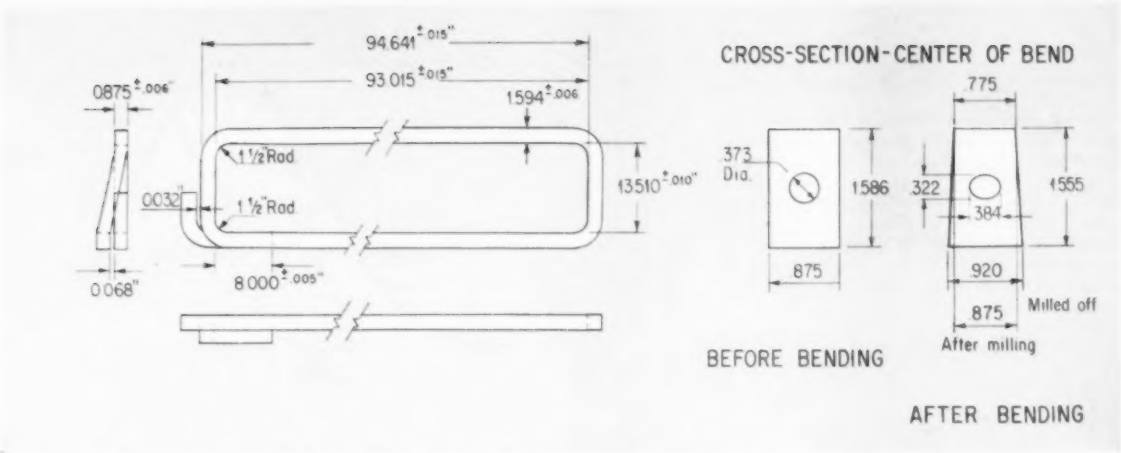


Bend was made to preset, adjustable angle to compensate for springback. Stop block clamped to workpiece bar gaged space between bends

400 tons of copper coils are being built into a 842-ft-dia circle of electromagnets for Brookhaven National Laboratory's new Alternating Gradient Synchrotron. These will confine the proton beam in the relatively small cross-section vacuum chamber. This huge particle accelerator will have an energy potential of 25-30 billion electron volts, and will be the world's largest unit of this type.

Bending the turns of the magnet coils to their rectangular shape was a tough job because of the precision required. After the extruded pure copper bars were bent edgewise, the 0.373-in. central hole could not be more than 1/16 in. out of round, and its area had to be maintained within ± 2.5%. Thickness of the bars at the bends, which was increased to 0.920 in. at the inner edges of the smallest rectangle by the forming operations, had to be reduced to 0.875 in. again by side milling.

Tooling for the bends was unusually simple. The bars were draw bent, so they were clamped to a rotary bending form with no mandrel or wiper applied. Springback was controlled by overbending slightly. The bending form was split horizontally so the top piece could be spring-loaded to simplify removing the

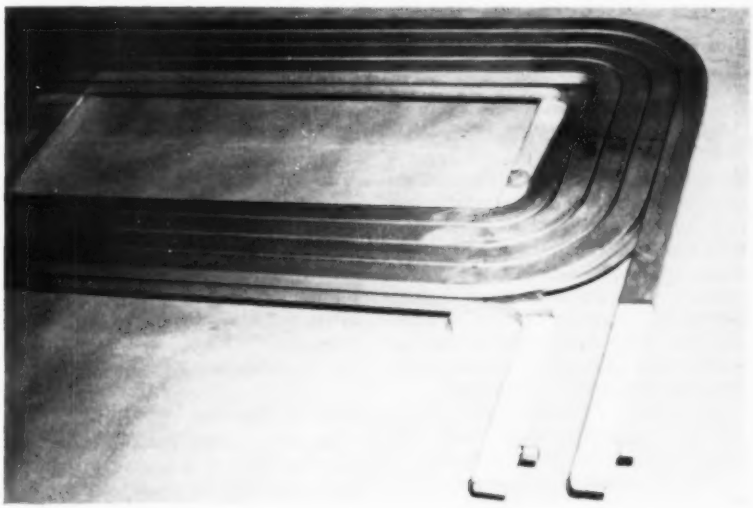


Coils are soft pure copper, which simplified overbend allowances to control springback. Final operation was milling inside-edge buildup at the bends to compensate for bulging at the inside corners

for Brookhaven Synchrotron

work after the bend was made. Lap-over clamp and pressure dies held the two parts of the bending form firmly together.

Coil bending was done at National Electric Coil Co's plant in Columbus on a No. 2 Pines hydraulic bender. Distance between bends was measured with pin gages between a fixed block on the machine bed and a stop block that was clamped to the work.



Individual turns were assembled to build up a complete coil. Uniform nesting of turns was made possible by accurate bends

Kaiser bids for commercial forgings market

Up to now, 90% of aluminum forgings have been produced for manned aircraft, missiles and other defense projects. Consequently, from a high point of 200-million lbs a year, the industry is now down to 50 million lbs a year—forcing producers of forgings to look for commercial markets.

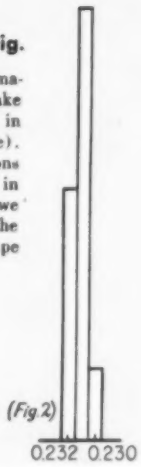
Kaiser Aluminum & Chemical Corp has just expanded its Erie, Pa, plant, confident that it can sell the virtues of aluminum forgings to commercial users on a basis of price, quality and lower overall net cost of finished parts.

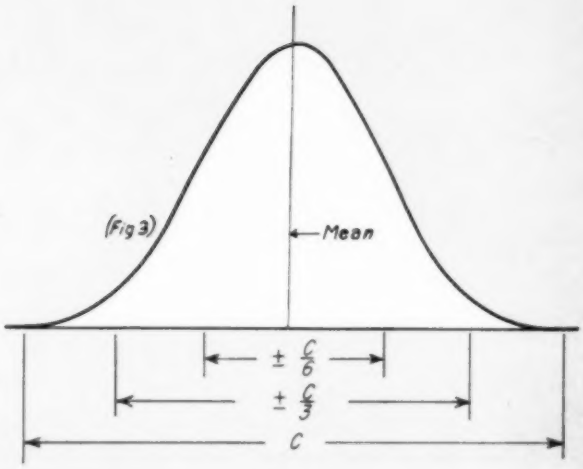
Modern press equipment and new techniques have gotten the price of some aluminum forgings down to 60-70¢ a pound. Other forgings, such as those of the no-draft variety, will cost much more, of course, but they eliminate expensive or "impossible" machining jobs.

Kaiser's expanded and modernized Erie plant can now provide full lines of draft-free, low-draft, commercial, precision or impact forgings. Impact forgings can be made in sizes up to 16 in. dia by 60 in. long.

Kaiser's $5-million expansion program has added three new Bliss hydraulic presses of 3000, 5000 and 8000 tons capacity—all equipped with advanced electronic controls so that forging conditions can be worked out by the process engineer. And forging results are precision controlled regardless of an individual operator's ability.

Application of the Laws of Chance . . . Fig. 1—To get a meaningful picture of how well a machine can make parts within tolerance, we must take enough samples (63 pcs here) and measure them in fine enough increments (0.0001 in. in this case). **Fig. 2**—The distribution of actual part dimensions produced is hidden when we measure the same lot in too coarse a manner (0.001 in.) **Fig. 3**—When we properly measure a group of parts, the outline of the "bar chart" or histogram begins to assume the shape of a normal curve





Job shops can use machine capability

When making short runs, it is important to catch problems early. If you take the trouble to get some experience on machine capability of specific machines, you can predict results on other jobs with like tolerances. And you can set up some ground rules for your operators

By Ross H Johnson, supervisory engineer, Quality Control Dept. Air Arm Div, Westinghouse Electric Corp, Baltimore

You would think that "statistical quality control" and "machine capability" are dirty words around a job shop. The fact is, though, we have found the way to make use of these concepts for runs of a few hundred pieces. For example, we might make less than 150 pc on a screw machine with reasonable certainty that each part will be within tolerance.

As I look at it, application of the machine-capability chart in a job shop has these advantages:

1. It allows the people concerned with the machine to gain a better understanding of its ability before the job is started.

2. During the job run, the operator can recognize when the machine should be adjusted, in many cases before defective parts are produced.

3. The chart often indicates a trend, giving hints of action to take.

In short-run operations, the job is often completed before enough data can be gathered to produce the $\bar{X}$ and R charts favored by quality-control men for mass-production work. The method that we use tries to determine the standard capabilities for a machine. Then, the requirements of the drawing can be analyzed and the chart drawn before parts are made.

It is our experience that where the length of run is less than 8 to 16 hr., it may not be useful to draw a chart. However, it is still essential for the person making the set-up to understand the capability of the machine in its different modes of operation, such as OD, length, depth, etc. And this leads us to:

What Is Machine Capability?

Machine capability is defined as the ability of a machine to control dimensions of a given operation, and to produce parts of consistent quality within the drawing or specification tolerance. Variations in this capability occur with different materials, different modes of operation, tool differences, tool wear, and skill variations between operators.

When a machine has been set up and produces a given dimension on a group of similar parts, the measurements of the dimension from part to part are never exactly the same. The pieces may vary from nominal by thousandths, tenths of thousandths, or even millionths. The greater the capability of the machine, the less the variation. A machine producing parts differing only by millionths of an inch would have a higher capability than one producing parts differing by thousandths of an inch.

Fig. 1 shows the spread of a particular part dimension as measured with a gage reading to 0.0001 in. If we measure these items with a gage capable of 0.001 in. then we would get a picture similar to Fig. 2.

It is a good rule to measure at least 50 items to enough precision to get from 10 to 25 increments of measurement. The spread of increments then roughly shows machine capability.

For a given scale, the wider the spread out from the nominal, the less the capability. If we take a few parts, they will usually be more closely grouped around the nominal than if we take a larger sample. As we take more parts, the spread tends to get wider up to a certain point and assumes the shape of a normal curve.

Capability Limits

To conform to a true normal curve, 99.7% of the parts should be within the capability limits shown in Fig. 3. If capability is equal to C, then about 67% of the parts are within $\pm$ C/6 of the nominal, 95% are within $\pm$ C/3 of the nominal, and 99.7% are within $\pm$ C/2 of the nominal. A standard deviation or sigma is then defined as C/6. Thus, capability can be defined as equal to 6 sigma.

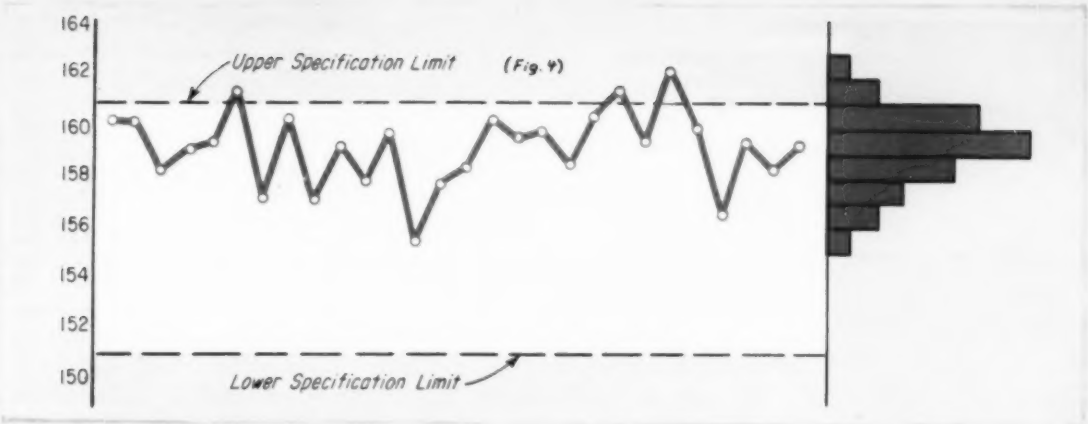


Fig. 4—Some parts exceed the upper tolerance limit, could be missed by ordinary periodic checks. If we move the nominal dimension down, the chances are good that all of our short-run parts will fall within tolerance limits

Objectives of a Study

An analysis of capability has two objectives: to improve part quality and to reduce costs. Savings are achieved by reducing defectives and inspection, if lot quality can be assured.

Fig. 4 shows a lot which could be produced without detection of defectives by ordinary periodic checks, especially in a short run. The chart shows measured dimensions and a histogram of the dimension measurements. Spot checks could select parts within tolerance and overlook out-of-tolerance parts. Inspection of a sample after the lot is produced might not detect any indication of a problem. Also, we know from experience that 100% inspection is impractical from a cost viewpoint, but not likely to find all the rejectable parts nor establish remedial action.

In Fig. 4 the natural process variation allows some of the part dimensions to go outside of the tolerance at random. If the distribution can be moved down with respect to the tolerance limits, there will be plenty of room to fit the distribution. The process will be satisfactory so long as the nominal does not get too close to one or the other of the limits. Bad parts will be avoided if the operator can set his machine so that the ends of the distribution will not extend over the tolerance limits.

These objectives are general. What information does the operator need to control the operation:

1. He must know where to start the operation, or the nominal dimension at which to aim.

2. He must know how often to check part dimensions and how many pieces to check at each inspection.

3. He must know when the operation is approaching a condition where defectives may be produced, if possible before bad parts are actually produced.

Job Shop Problem

How is the job shop different from the production plant in respect to application of statistical methods to machine capability and quality control?

The first difference relates to the need of experience or data on the particular operation to establish quality-control charts or limits. On a production run, the ability of the operation to produce the part can be determined. Significant variations can be recognized and charts plotted. In many job-shop cases, the run is completed before the capability of the particular machine can be evaluated.

A further phase of the problem is the possibility that several dimensions are produced by the operation. Again, the short running period makes it difficult to establish the necessary controls. In making charts, dimensions or measurements are needed to calculate the limits. Although many operations are similar, each job has variables. It is not easy to recognize all variables that affect quality. Therefore, we must collect general information to be used before the job is started.

Determination of Capability

In production run, machine capability is usually determined for a particular machine and item. For job-shop usage, machine capability is determined for a machine type and type of operation and is therefore not so precise. For example, a screw machine may be capable of holding ± 0.002 in. on an outside diameter, but only ± 0.004 in. for cut-off. Other variables such as the type of material and tools will affect capability of the operation being performed.

We must predict capability although we have little or no experience on the particular job. We do this by relating the job or a portion of the operation to one on which we have had previous experience. For example, Figs. 5, 6 and 7 are plots of dimensions on three parts made on a screw machine. They are different dimensions made on similar but not the same machine with a different material. All dimensions are outside diameters. By running several checks on each machine, using different materials, we find there is some variation with material, but it is small. Therefore, when we get a new part or operation, we can closely estimate the probable variation to be encountered by comparing the job with a group of similar operations. For example, a type of screw machine may hold ± 0.002 in. on outside diameters and ± 0.004 in. on length, regardless of the material, operator, or specific machine.

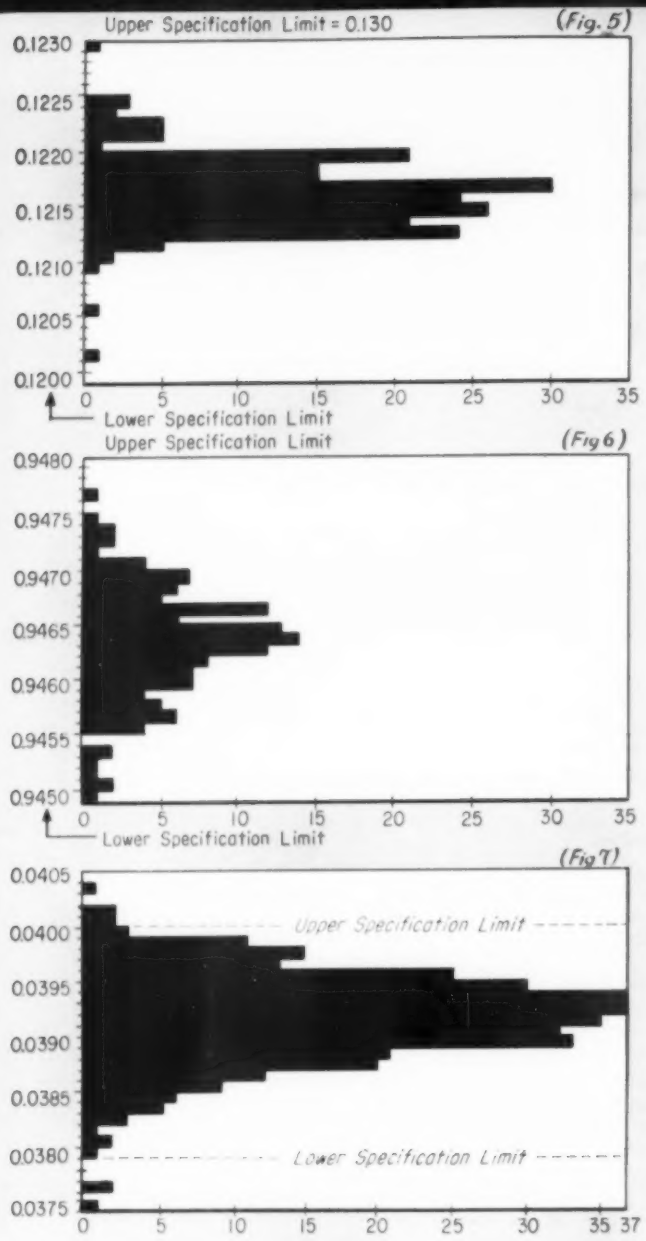
Quality Control Plan

To accomplish our objectives, we must supply the operator with certain information:

1. Basic capabilities of the machine as defined.

2. The modes of operation affecting dimensional variations and effects of different types of materials.

3. The procedure to follow as the



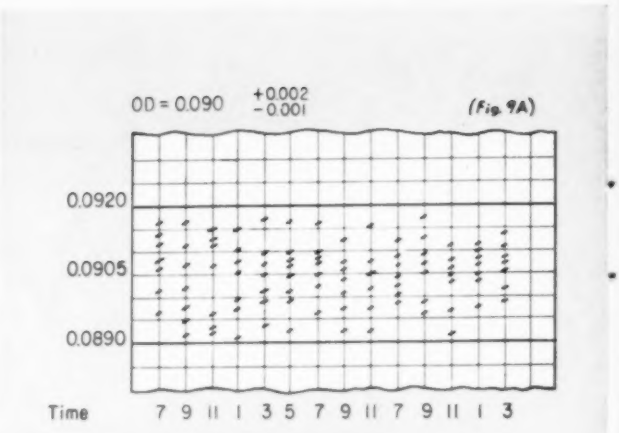


Fig. 9 . . . A quality-control chart of this type is necessary when the tolerance is tight compared to the machine capabil-

Analysis of Process Quality Capability . . . Fig. 5—A steel screw with an OD of 0.125 in. nominal, has a tolerance of ±0.005 in. Machine capability is determined by measuring 200 pc to 0.0001 in. Measured dimensions fall within the range 0.1202-0.1230 in., or a capability of 0.003 in. When determining whether the first piece is acceptable, according to the rules in Fig. 8, Col. *F* (a), it is seen that a 0.1210-in. part is closer to the lower specification limit than the 0.002 in. permitted. Any upward adjustment would be slight, however, in order to allow for tool wear

Just Adequate . . . Fig. 6—The part is steel, the OD is dimensioned 0.945 in. +0.003, −0.000, or limits of 0.948-0.945 in. According to the process analysis, the capability of the machine is adequate for the job, but no more

Some Parts Out of Tolerance . . . Fig. 7—The OD of a brass part is dimensioned 0.038 in. +0.002, −0.000. Of 359 pc, eleven parts were produced outside the 0.038-0.040 in. limits. Here, the machine capability is 97% but could go as low as 95%. Because the tolerance spread is less than the capability, some parts out of tolerance will be produced

Fig. 8 PATROL INSPECTION GUIDE FOR AUTOMATIC SCREW MACHINES

A	B	C	D	E
Operation and Total Tolerance Spread in Inches	Patrol Frequency Once Per	Patrol Sample Size	Tool Tryout and 1st piece Sample Size	Chart Read?
OD 0.003 or less	2 hr.	7	12	Yes
or 0.004-0.009	4 hr.	3	6	Yes
ID 0.010-over	4 hr.	3	6	No
Length 0.006 or less	2 hr.	7	12	Yes
or 0.007-0.015	4 hr.	3	6	Yes
Depth 0.016-over	4 hr.	3	6	No

F

1. If no 1st piece or sample part is closer than (a) to tolerance limits, accept.
2. When total tolerance speed is 0.003 or less on an OD or ID and 0.006 or less on a length or depth, accept if all sample parts fall within tolerance limits.
3. If a patrol sample piece is beyond (a) the control limit, take (b) additional pieces.
4. Any pieces out of tolerance require analysis to determine cause.

(a)	(b)
0.001	10
0.002	10
0.002	10
0.004	10

operation moves toward completion.

4. The risks that are acceptable in exceeding tolerances.

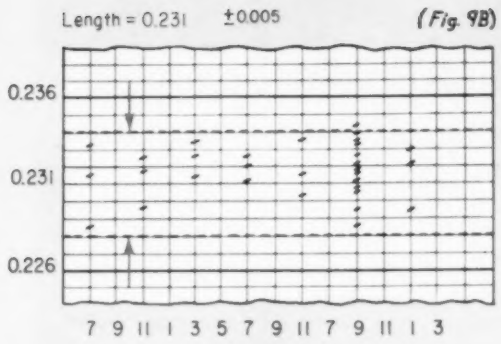
5. Nominal dimension at which to start the operation, so that by allowing for tool wear we can obtain the longest run without re-setting the machine or producing defective pieces.

When the capability and causes of variation are understood, the operations conducted on the machine will fall into one of three categories:

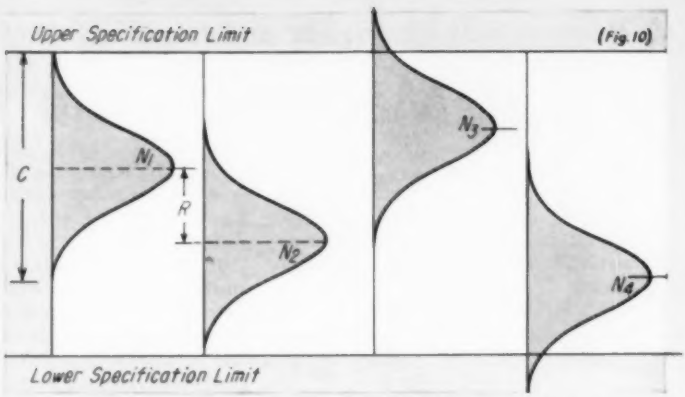
1. The tolerance allowed is wider than the machine capability.

2. The machine capability is approximately equal to the tolerance.

3. Tolerance is less than the machine capability. In this case it is impossible for the machine to produce 100% good parts.



ity. On the length dimension, the control limits are between the arrows, or closer than the specification limits



What Odds Do You Want ? . . . Fig. 10—You won't exceed tolerance limits, so long as the nominal remains within region *R*. The desired risk and control limits can be set by moving N up or down

Instances of the first kind are desirable, because they are the easiest to control.

Guide for Operators

A typical guide for the operator or patrol inspector in determining acceptability of the operation is shown in Fig. 8. This guide tells the operator whether use of a quality-control chart is required, a portion of which is shown in Fig. 9.

The use of quality-control charts is required where the tolerance is tight relative to the machine capability. Specification limits would be entered on the form for the two dimensions plotted. The plot at left shows results of a case where 7 pc. are chosen every 2 hr. The plot at right shows a case where 3 pc. are selected every 4 hr. In this second plot, the arrows indicate the control limits, which are narrower than the specification limits. The control limits are given to the inspector or operator in Column F (a) of Fig. 8, which gives the distance inward from the specification limits that the control limits are to be set. In the next to the last sample of the case illustrated in Fig. 9, one point of the 3 was out of the control limit and although it was within the specification limit, an additional sample of 10 was taken and plotted.

The numbers in Column F (a) of Fig. 8 are established by considering the tolerance, the machine capability, and the risks to be allowed.

To Set a Risk

In Fig. 10 a machine with capability C is producing a dimension with specification limits as shown. For a given nominal value, the machine will produce dimensions within C, the span of the curve, 99.7% of the time. So long as the nominal remains within the region *R*, the capability curve will not extend beyond the specification limits. If one may allow a greater chance of parts exceeding the upper specification limit, the nominal might be permitted to go to position N_3 which allows about 2½% of parts above the upper specification limit.

Example:

Capability $C = 0.006$ in.

Diameter Specification =

0.900 ± 0.008

If the nominal is set to assure 99.7% parts within specification limits (Like N_1 and N_2 in Fig. 10), then the nominal could go to within 0.003 of either limit. The control limits would become 0.905 and 0.895. If it is desired that the setting of the nominal will assure 95% of parts within specification limits (like N_3 and N_4 in Fig. 10), the nominal could vary from 0.906 to 0.894. Considering the tolerances, capability of the machine, and the importance of the dimensions, the desired risk and control limits can be set. Most texts on statistics or quality control give the proportion under the normal curve for any distance from the nominal in terms of the capability equal to six standard deviations.

Acceptance by Shop Personnel

A skilled operator will know how well the machine will hold tolerances under various operating conditions or with different materials. He thus has knowledge which is better, in some ways, than capabilities determined through statistical studies. However, it is difficult to differentiate in some cases between actual causes of variations and operator prejudices.

What advantage, then, do charts have over the operator's knowledge? The chart shows the trend in piece size, the specific limits, and the objective limits based on certain probabilities. Sometimes it is difficult to convince the operator that there is trouble when the parts are within specification. By charting the information the variations become apparent. Such variations are likely to permit some pieces to exceed tolerances, and these may not be caught, if only sampling inspection is employed.

The quality-control engineer is thus faced with the problem of selling statistical techniques to the operator. His success depends on whether the operator accepts these concepts:

1. Check parts periodically even though the setup has shown that the operation will produce good parts.
2. Change the frequency of inspection based on the tightness of tolerances involved.
3. Plot charts.

The quality-control plan will be accepted by the operator if he understands it and recognizes its help to him.

Quality Capability Specifications

A machine capability study can be utilized for purposes other than direct control of process quality. A specification for each machine, or group of similar machines, can show the C's as illustrated in Fig. 3. The specification will state where there are differences in the capabilities due to different machines, types of parts, materials, and in the mode of operation.

New studies on speeds and feed may help you in . . .

Machining the tough ones

New information on feeds and speeds will remove much of the trial-and-error factor from machining operations on high-strength, heat-resistant materials—and more information is on the way.

A progress report, presented at the SAE National Aeronautic Meeting in New York, tells the findings to date of an Air Force machinability research program being conducted at Metcut Research Associates, Inc.

Turning operations are the least difficult of those studied, with drilling and tapping occupying in-between positions, say John Maranchik, Jr, vice president, and J V Gould and P R Arzt, project engineers at Metcut, authors of the paper.

The tests made so far at Metcut have covered four groups of high-strength, thermal-resistant alloys represented by AISI 4340 and Vasco Jet 1000, both quenched and tempered to R_c 50 to 55, and AM-350 and A-286, both solution treated and aged.

Ground rules for turning

In turning these materials, they predict good tool life with conventional tools, techniques, and tool geometries, combined with these general recommendations:

- Use a rigid machine and strong, solid tools and fixtures.
- Use the proper grade of carbide. For a given type of carbide, select the hardest grade that will perform without chipping.
- Use cutting speeds, feeds, and tool geometries selected from turning data obtained under controlled cutting conditions.

For a representative example from their tests, a tool life of 30 min was achieved when machining AISI 4340 steel (R_c 52) with grade C-8 carbide under the following conditions: feed —0.009 ipr; speed—200 fpm; depth of cut—0.100 in.; with a mechanical chip breaker and no cutting fluid. Tool geometry was –5° side and back rake angle, 15° side and end cutting edge angle, 5° relief angle, and 0.032-in. nose radius. The tool-life end point, for both the turning and milling tests, was arbitrarily set at a wear land of 0.016 in. or localized breakdown, whichever occurred first.

This same tool geometry was employed for turning all four of the materials tested, the only exception being a 0° back rake angle for the AM-350 stainless. Optimum speeds and feeds varied, of course, with the different materials.

It was in milling that the greatest problems arose, and here, some surprising results were developed. The best procedure for one metal may be the worst for another. Even when only one metal is involved, a change from one type of cut to another may require switching to a different grade of carbide.

Face milling

In face milling Vasco Jet 1000 (R_c 50), it even turned out that a C-2 grade of carbide—intended for cutting non-ferrous material—had a tool life five times as long as a C-6, general-purpose, steel-cutting grade. Both tools were operated under the same conditions. Then, in performing the same work on AISI 4340 (R_c 52), the C-6 grade stood up better.

However, in other respects, the face-milling studies showed very similar results for these two materials. Tool geometry, though developed separately, was the same for both.

Best results were achieved with a 5-in.-dia, 5-tooth mill, having axial rake of 0°, and radial rake of –15°. The test cuts were 2 in. wide by 0.100 in. deep, with a feed of 0.005 ipt and no cutting fluid.

Run-out is critical

One important finding was that cutter run-out is a critical factor in tool life. A run-out of 0.003 in. reduced tool life by about 25%, and a run-out of 0.005 in. dropped it by 65%.

In side milling, the C-2 carbide again did better on Vasco Jet 1000, and the C-6 did better on AISI 4340. In addition, the C-2 worked best with down milling and the C-6 with up milling.

Cutter geometry was also different. The C-6 grade with AISI 4340 had a –5° axial rake and a –10° radial rake, whereas the C-2 carbide cutting Vasco Jet 1000 had an axial rake of 0° and a radial rake of –15°.

In both cases test cuts, 1.750 in. wide by 0.100 in. deep, were made with 7-in.-dia, 6-tooth cutters. Tool life with the C-6 tool on AISI 4340 (R_c 52) was 380 in. of work travel at a cutting speed of 145 fpm and a feed of 0.0075 ipt. Maximum tool life for the combination of C-2 and Vasco Jet 1000 (R_c 52) was 390 in. with the same feed and speed.

End-milling tests showed that HSS cutters were not practical at a hardness of R_c 50. Carbides also gave some trouble until the cutters were redesigned for greater rigidity. The result was a 1¼-in.-dia, 4-tooth mill with a special 1¼-in.-dia shank and only ¾-in. flute length. Axial and radial rake were both 0°.

Once again, the C-2 grade carbide proved better than the C-6, this time for both AISI 4340 and Vasco Jet 1000. Optimum feed was also the same for both: 0.0015 ipt. When making a ¼-in.-deep cut in AISI 4340 at 50 fpm, the tool lasted for 78 in. On the same cut in Vasco Jet 1000, at 60 fpm, it was good for 105 in.

Slotting tests also showed a superiority for C-2 carbide with both materials. A bi-negative 5° axial rake and a 10° radial rake gave the longest tool life. Too, tool life was several times as long with down milling as it was with up milling.

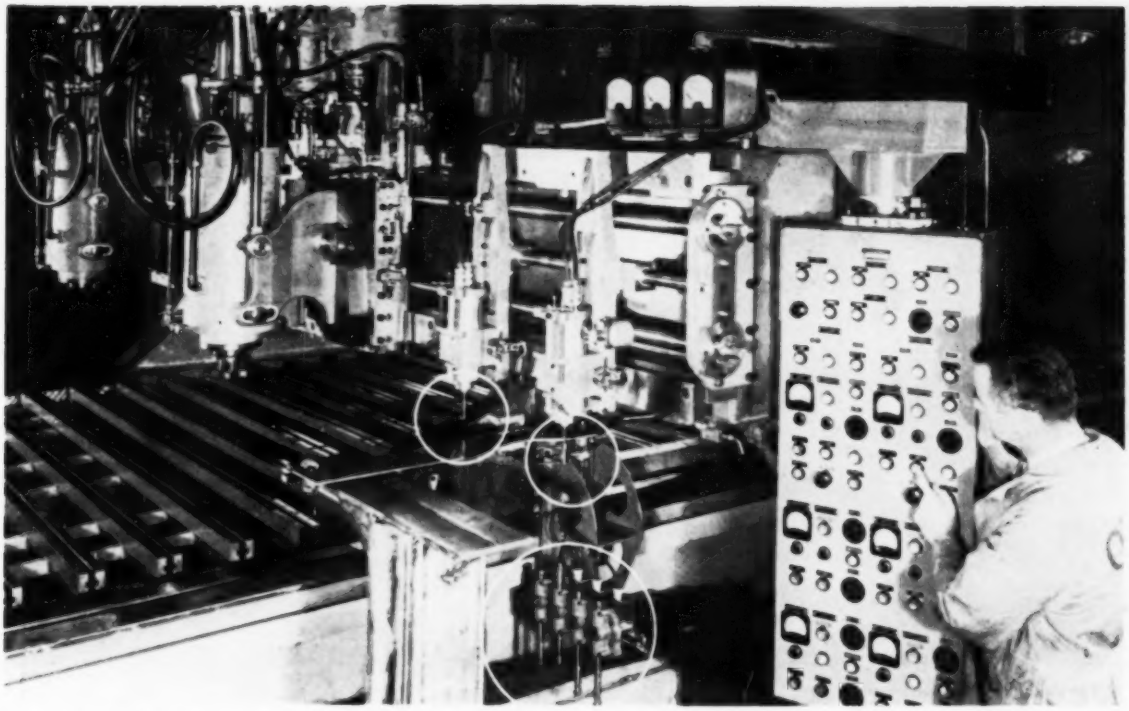
Six-tooth cutters, 6 in. in dia, cut slots ¼ in. deep by 1 in. wide at a cutting speed of 190 fpm and a feed of 0.005 ipt. Under these conditions, the cutter lasted for 225 in. in AISI 4340 and 300 in. in Vasco Jet 1000.

Drilling and tapping

When drilling hardened steels, the drill length should be as short as possible, and the entire setup as rigid as possible. In general, Metcut achieved longest tool life with crankshaft-pointed T-15 drills using highly sulphurized oil, diluted 1:1 with light machine oil.

In test drilling (¼-in.-dia, ½-in. through holes) the best speed was 20 fpm. Feed varied: 0.001 ipr for AISI 4340 (R_c 52); 0.0005 ipr for Vasco Jet 1000 (R_c 52); 0.002 ipr for AM-350 (R_c 47); and 0.005 ipr with A-286 (R_c 34).

Tapping these steels is greatly aided by a cutting fluid made of three parts highly chlorinated oil and one part inhibited 1, 1, 1 trichloroethane. The work was performed on R_c 52 material at a speed of 5 fpm with an M-10, 4-flute taper tap with a 0.015-in. land. Preliminary tests show promise of longer tool life with nitrided taps, but this factor is still being studied.



Six controlled motions using four Onsrud tracing heads with GE selsyns and two GE single-dimension tracing heads, at Boeing Aircraft Co. Setup demonstrates how single-dimension units can control motion for complex shapes

Build-up to numerical control... a review of machine-tool programming

By Darren B Schneider
Specialty Control Dept.
General Electric Company
Waynesboro, Virginia

There are many different ways to program a machine tool, or a process. Numerical control is the newest way—and probably the ultimate for some time to come. But it pays to consider them all before deciding which will do the best job per dollar invested

What is a programmed machine? An acceptable definition might say: A machine in which at least a part, if not all, of the operations or functions are performed according to a plan conceived in advance of starting the machine. Hence, a study is made of the work to be done and a set of machine instructions is prepared to carry out the work program.

By this definition, programmed machines had their beginning many years ago. In these early machines the operating sequence was usually set up by mechanical timing actuated by limit switches or other mechanical devices.

First serious attempts at programming machines by means other than mechanical began in the early 1940's. Programs then were supplied as templets; generally either wood or metal.

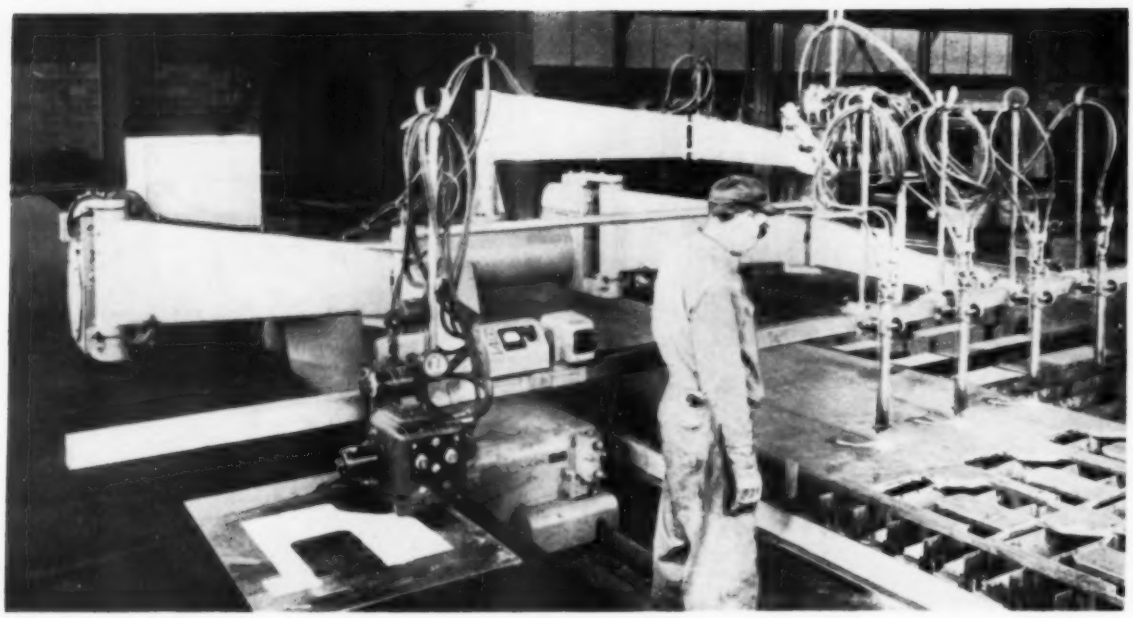
Each templet usually formed a cross section of the desired finished product, hence was limited to simple two-dimensional shapes. The edge of this templet was followed by a stylus and the machine duplicated in the work the surface described. During the same period, photoelectric following of line drawings came into use.

In the late 1940's instructions placed on magnetic tape were used to operate a machine and to produce a finished part. Somewhat later (early 1950's), punched-card and punched-tape programs appeared. Thus, it has taken about 15 years to reach the present level of programming.

It is not only necessary to have the program but to be able to "read" it. One recognized method of tracing solid templets is by a contacting stylus which, in some instances, opens and closes contacts to initiate feed drives to correct the motion. More commonly, the deflection of the contacting stylus (either increasing or decreasing from a null point) produces a continuous electrical signal. This signal is used in a servo system to continuously control feed drives by returning the deflected stylus to its null position. In some systems using hydraulic power drives, the deflection of the stylus directly operates hydraulic valves which control the flow of the hydraulic fluid to produce the correcting motion.

Following line drawings photoelectrically can be accomplished by noting the change (that is, increase or decrease) in the quantity of light as the drawing is traversed. Or, the following action can be achieved by using a rotating light spot and observing photoelectrically the point at which the light crosses from the white to the dark region or vise versa. Pulses produced by this moving spot of light are compared to a reference, usually a phase reference, and the shifting of these pulses with respect to the reference is used to steer the machine.

Stored programs on magnetic tapes



Photoelectric line follower (lower left) controls a battery of cutting torches. Sensitive cell follows line created by dark and light portion of pattern or drawing

are in magnetized sections or blocks which produce voltage pulses as the tape is passed under a reading coil. Thus, motion of the tape is essential to producing the induced voltage in the reading coil. Some systems present these pulses as discrete increments of motion which are compared against similar pulses obtained from movement of the machine slides. Differences between the command and the position pulses are used to produce the required velocities. General Electric's magnetic-tape system makes a time comparison of the motion pulses with a reference pulse (both located on the tape). Then the variation in time between pulses is used to actuate the feed drives through a selsyn follower.

Controlled Motions

In tracer controlled machines, regardless of the particular machine being controlled, the system is usually referred to in terms of the number of motions or dimensions being controlled. Thus, a one-dimension system applies the signal from a tracing head to only a single motion.

In a two-dimension tracer system the tracing head produces a dual signal which is used to control two motions simultaneously so that a full 360° of control is available. In two-dimension control, if we think of the two motions as X and Y, both feed drives are capable of going from zero speed to top speed and back to zero in one direction; then reversing and going to top speed in the other direction and again returning to zero. In other words, as a 360° circle is being traced, velocities of the two feeds vary as sine and cosine functions.

The selective 2D system has a tracing head which produces signals for deflections in any three mutually perpendicular axes. However, only two of the axes—XY, YZ or XZ—may be used simultaneously. Still, by proper selection of pairs of axes, a complete spherical shape may be followed. In a two-plus-one system, or simultaneous three, the tracing head is so constructed that three signals representing three mutually perpendicular motions can be produced simultaneously; the machine operates in three dimensions at one time. However, this system cannot trace a sphere—or any other smoothly varying three-dimensional surface—because the tracer requires a templet which produces a definite path defined by both a side and the bottom of the templet.

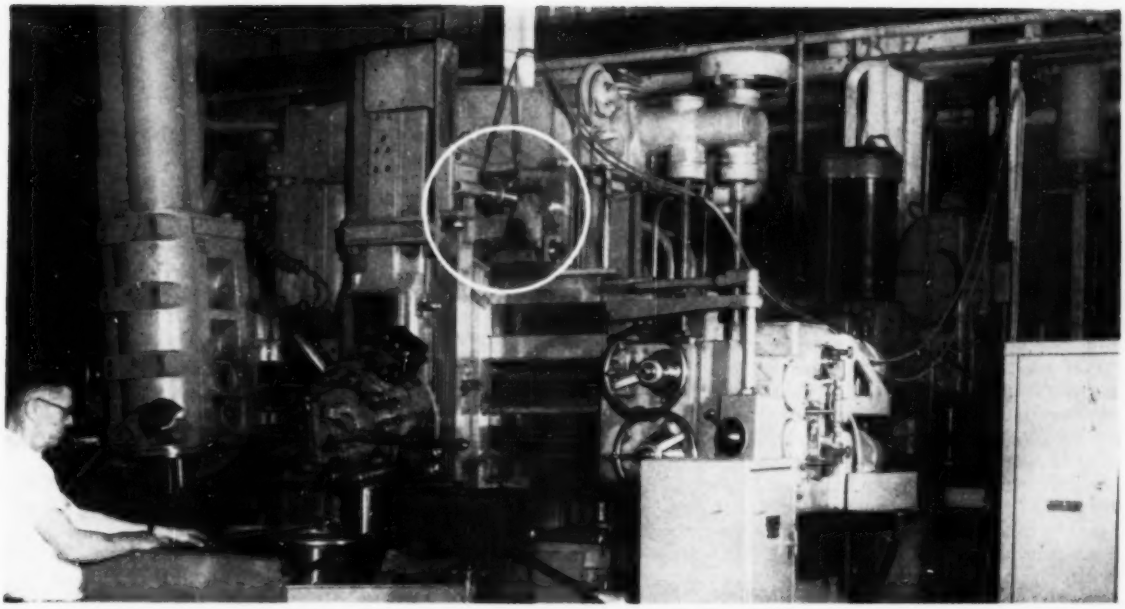
At present, photoelectrically controlled machines have been limited to two-dimensional shapes. Punched-card or tape-controlled machines, when used for point-to-point positioning, are unlimited as to the number of motions, but each motion is separately controlled from an individual block of data. Machines controlled from magnetic tape programs also have each motion individually controlled. Here a channel or channels on the tape are used for each feed drive. At present, this system is limited to 14 channels for 1-in. wide tape. Usually, 7 channels are available for controlling motion and the other 7 channels are used for reference and auxiliary functions. Of course, more motions can be controlled if the auxiliary functions are decreased or coded so a single channel can handle more functions.

Expected Economic Gains

We have discussed how programmed machines work—now, how can they be useful? As we know, few companies will use a more complex machine (except in laboratory work) just to be able to say that they have the most advanced techniques. The economics of the system must be justified.

What are the abilities of these systems which make them economical? First, programmed machines minimize human error. Each part of a lot is just like all other parts. Also, with a correct program the first part in a lot is acceptable. Scrap is rarely produced during machine set up. Consistency of operation also reduces inspection requirements and lowers costs. Too, the ability to store the program and reproduce a part at a much later date (even with a brand new operator) means less expensive parts and a lower inventory.

Programmed machines can make more complex parts (operations can be performed which even the most skilled operators can't reproduce).



Two-dimension control is used for contouring on Bullard vertical boring mill. Tracer follows metal templet shown (inset)

Up to five motions on a single tool have been controlled simultaneously and machines with as many as five cutters, having a total of 13 motions, all operating at once, are in operation. Elimination of many steps found in our present methods is being achieved by the more advanced machine tools, with systems which permit going directly from a machine drawing through a computer to the machine for completing the part.

Now that we know what the various control systems are called and what they can do—what is the investment? Of course, the cost of the system depends upon many factors such as the amount of auxiliary machine control included, special features, type of construction, etc. Therefore, costs can only be representative. The following rough figures apply for tracer-controlled machines using electrical drives. A one-dimension system costs between $5,000 and $10,000; a two-dimension system is roughly $10,000 to $15,000; a selective-two-dimension and a two-plus-one system are in the neighborhood of $15,000 to $20,000.

A two-motion punched-tape positioning system costs $8,000 to $15,000 with punched-card input somewhat more as a result of the more expensive data-handling equipment. For a three-axis (that is, three controlled motions) magnetic-tape unit, one can expect to pay from $35,000 to $50,000. Additional motions are not proportionally higher, because the high cost of the tape handling mechanism is basic to every magnetic-tape control. For instance, a five-axis control can be obtained for upward of $50,000.

Basic figures given above do not include equipment for preparing the programs. The cost of making templets, cost of preparing punched cards or tape, or preparing the magnetic tape is extra. These figures are best estimated by people who contemplate buying this equipment, because many complanies already have programming equipment available in their plants.

Machine Limitations

So far we have only talked about machine controls. What about the machines themselves? A potential user must recognize that the machine is as important to the overall success of the system as the control, because a poorly built machine will destroy the value of a more precise control.

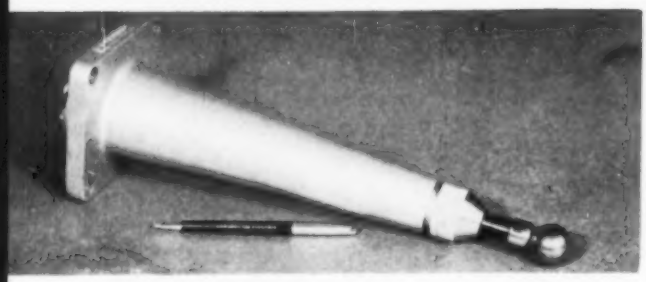
What are the most important machine characteristics affecting operation? Probably the most critical are backlash and wind-up. This is the total free play between the machine element and its driving unit. A machine having backlash and wind-up has "dead zones" (regions where the feed drives run but no machine motion takes place) which cause instability and poor accuracy. This factor is most evident during reversal of the feed drives or where machining is being done along one axis.

Next to backlash, stickiness is most detrimental to successful control. It arises from variations in the coefficient of friction (stick-slip) between the sliding surfaces. Combined with wind-up it can be extremely aggravating, and the result of these two conditions working together usually establishes some minimum speed below which smooth operation or accurate control cannot be obtained.

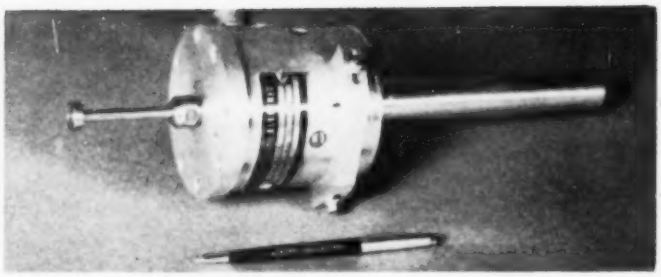
Friction, beyond its usual effects and within limits, is not necessarily bad. It produces a damping action which will assist the control when slowing down. However, when a speed increase is required friction subtracts from the accelerating force available. Thus, friction produces a non-linear effect which, if too great, can be exasperating.

Other detrimental machine characteristics are deflection of the machine elements and its close ally—vibration. Deflection is difficult to compensate because it is determined by operating variables. Deflection usually can be controlled by programming the final cut or operation to be within the capabilities of the machine. Vibration can be controlled only by providing machine members designed to provide strength and efficient damping.

As we now stand in our knowledge of metal cutting, servo systems, in general, are not limiting the machine's cutting speed. Rather, the machine tool itself is the limiting element. Whether the machine has a prepared program or not, metal can



A. One-dimension tracer head



B. Two-dimension tracer head

only be removed at a given rate. Consequently, faster operating speeds are not necessarily obtained by programming. Increased production results from reduced scrap, most efficient rate of metal removal, etc. Nevertheless, faster servo response will always be sought because increased response reduces the slowdown necessary for a rapid change in direction, for cornering or stopping.

Speed of response is limited by the acceleration and deceleration which the servo can provide. These are, in turn, limited by the available power of the drive. The greater the torque available for acceleration or deceleration the smaller the danger of errors on corners or other quick-change sections. Hence, to control the error within an acceptable limit it is often necessary to program a slow down as these rapidly changing sections are approached.

System accuracy is also directly related to the measuring device used. Feedback units take a variety of acceptable forms which won't be discussed here. However, it is necessary to understand that the inherent accuracy of this device—its resolution—is commonly erroneously used to indicate system accuracy. In other words, if the feedback unit can detect motion as small as 0.0001 in., this is its resolution.

Resolution in no way tells what the overall system accuracy will be. Some of the questions that need to be answered before the overall system accuracy can be given are: What will be the effects of machine limittations? Where is the measurement made? How will temperature variations affect the accuracy? At what speed can this smallest bit be detected and used?

It stands to reason that the system accuracy can't be stated as 0.0001 in. if we have to run at 0.1 ipm when we want to cut metal at 10 ipm. Asked more generally, can the control, when operated as part of the overall system, supply the necessary response in acceleration and deceleration without becoming unstable while using the smallest detectable error? If not, the control is not accurate to one part in ten thousand but more like one part in one thousand, or less.

When determining the maximum operating speed of which the system is capable, be cautious. For instance, in a one-dimension system the uncontrolled motion determines the rate of travel along the work. This might be, for instance, 100 ipm. The controlled motion which produces the desired contour may only be capable of a maximum speed of 10 ipm to maintain the necessary accuracy. Then, the speed of the servo system and its attendant accuracy are based on 10 ipm and not on 100 ipm. It might well be that, because of the slopes encountered along the contour, the uncontrolled motion could only be operated at 10 ipm in those regions where the slopes are most steep.

Program Preparation

What is involved in the preparation of the programs? Templet making is fairly straightforward. For a one- or a two-dimension system a cross section of the work is used and the templet usually is formed by hand. If a number of templets of the same kind are needed to control several machines, they can be reproduced automatically from the first templet. For other shapes requiring a selective two-dimension or two-plus-one system, the templet must be an exact copy of the desired piece, and again the first templet is usually manually prepared. Now, manual templet preparation can be eliminated by numerical control.

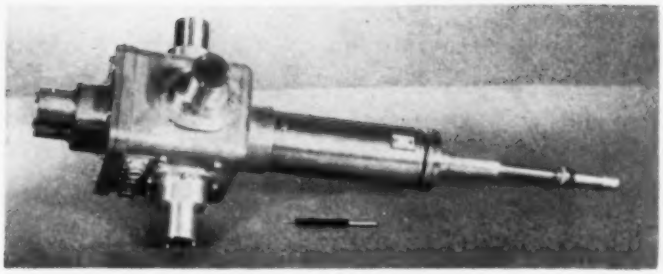
For the photoelectric line follower, the two-dimension shape is drawn on an appropriate material with the necessary contrast between white and black and then used directly.

For positioning systems using punched cards or tape, the work is planned and the coordinates of the operations to be performed on the piece along with other necessary data or machine instructions are tabulated. The card or tape is prepared using commercially available punching equipment and a compatible code. This method of programming finds its greatest use for intermittently operated machines such as spot welders, drilling machines and punch presses.

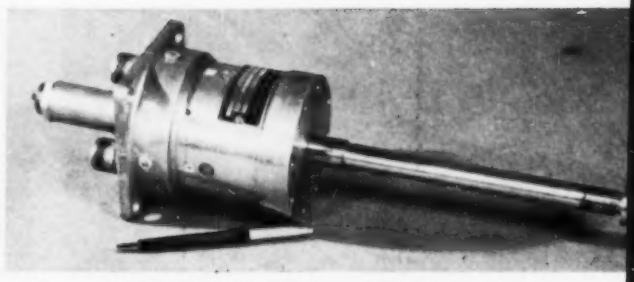
How is the information prepared for magnetic tape? The method depends upon the system. One of the earliest methods was record-playback, to record machine motions as a skilled operator put the machine through its paces. As more complex pieces were designed this became impractical; control was analog but not numerical.

Furthermore, where only small quantities are needed, record-playback is not economical. Then too, the machine can be controlled by operating it as a tracer machine while recording the motions, but again drawbacks similar to those in hand operation are encountered. Also, the first cost of templet preparation is high. Actually, where a great number of machines are required to produce large quantities of a particular part, it is more economical to use a magnetic-tape programmed machine to make templets for controlling operation of the other machines.

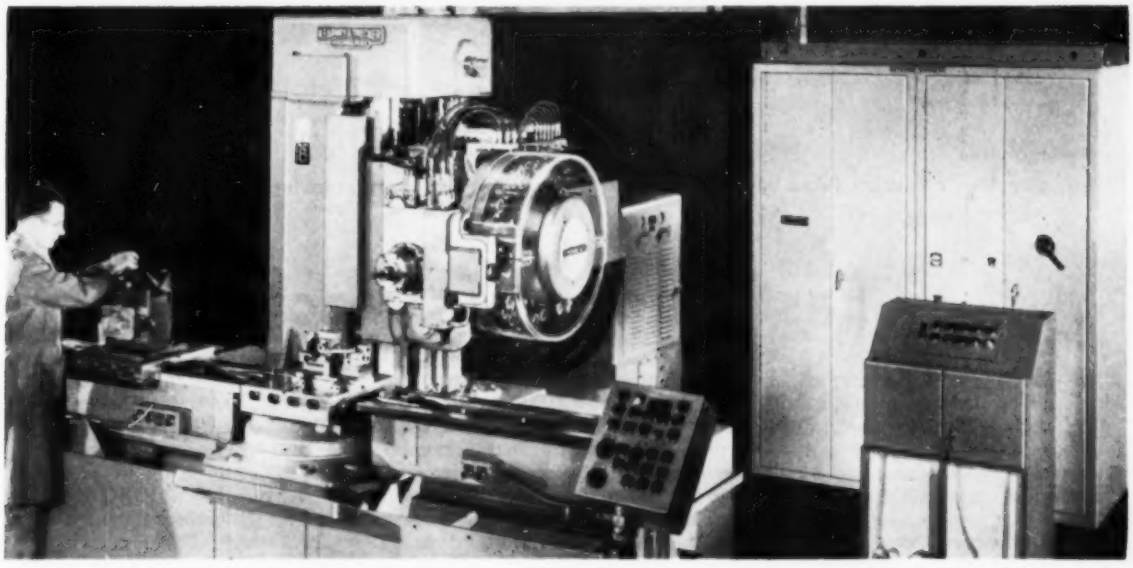
In magnetic tape program preparation, the most direct approach is to prepare the program from the engineering drawing. How, then, can the drawing information be placed on the magnetic tape? The answer is found in computers or similar equipment. Coordinate points of the drawing representing straight-line sections, circular arcs, other second-order curves, or simply an empirical curve broken into appropriate second-order-curve sections, are determined. With a general-purpose computer, such as the IBM 704, and appropriately prepared sub-routines for operating the computer, these co-ordinate points, plus the allowable toler-



C. Selective two-dimension tracer head



D. Two-plus-one-dimension tracer head



Discrete-positioning numerical control takes a giant step beyond templet programming as advanced versions like this Kearney and Trecker Milwaukee-Matic come into being. Tape not only controls dimensions, but positions part and selects correct tools, too. Basic geometric forms, electronically programmed into the system, can be selected as additional tape functions

ances for the work, plus the tool off-set and any other factors affecting the work are turned into the desired magnetic-tape program.

For some jobs, nothing more than straight-line interploation is used and the length of the line segment is determined by the curvatures and tolerances of the piece being cut. Other programs have been prepared using second-order interpolation in the computer, such as circles and parabolas, to reduce the number of points which must be handled.

Some systems have the computer elements built into the control and the complete equipment placed in the production area. Other systems separate the control and the tape-preparation equipment. In GE's system the tape preparation equipment and the control are separated. This has several advantages among which are: less equipment on the factory floor resulting in lower cost per machine, easier maintenance, and less downtime; placement of tape preparation equipment in an office area with the computer; and the ability to prepare and distribute programs for several machines from one preparation center.

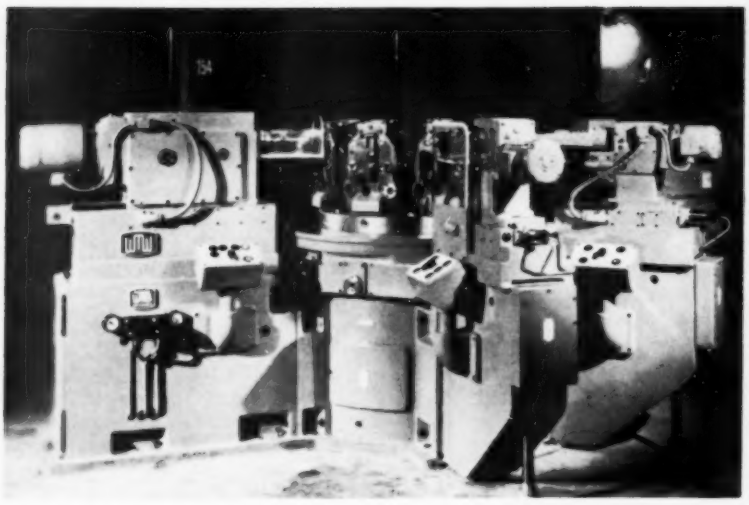
Crystal Gazing

What about the future of programmed machine tools? Computers are already widely used, and the gains realized for computer prepared programs for magnetic-tape systems are astounding. For instance, a test piece representative of a current aircraft part required 100 hours (including paper work) to make the templets for a tracer controlled machine and 3.5 hours to machine. It took a computer only 2.5 hours to prepare the program and machining was completed in one hour. Another machine used only 18 minutes to cut the piece; thus showing the advantage to be gained through the machine alone.

It does not take much of an extension of one's imagination to visualize a single brain center operating several machines simultaneously within one plant. This can even be extended further to a centrally located center or centers from which programmed information is sent by mail, by wire, or radio to many different points of manufacture for production of identical parts.

Our thinking, procedures, and personnel, with regard to this equipment, will be greatly altered within the next few years. Drafting and engineering techniques will change radically. It is not difficult to visualize the day when a drawing, as we know it, will be replaced by a table of numbers and equations.

Where will it stop—or will it? New machining techniques, new metals, and different forming processes will greatly alter the path we are traveling. I certainly cannot predict the outcome—only join you in guessing.



1 . . . Russia's Prime Minister Khrushchev looks over a rotary indexing unit

East Germany's machine tools

East Germany was the star of its own show on its own grounds at this year's Leipzig Fair, where the Communist countries annually show what they can do in designing and building machine tools (AM Apr 6 '59, p122).

East German machine tools were so outstanding this year by contrast with those of other iron countries that it is now almost certain that East Germany will be assigned almost exclusively to building complex, high-production machines suitable for automation, while other, less-talented satellites will confine themselves to production of simple machine tools.

Khrushchev visits the Fair

For example, one machine tool that caught the attention of visiting Russian Prime Minister Khrushchev (Fig. 1) was a rotary indexing unit made up of standard boring heads. Tooled up to machine sewing machine bodies, this machine has seven work stations to drill, bore, ream, tap and mill.

The circular table is also standard, includes an annular trough for collecting chips, which are swept into an exit chute by flexible paddles that move with the table. Machine's hourly output is 45 pieces.

Another attention-getter at Leipzig was a standard double-column planer (Fig. 2), which demonstrated heads for copy-planing and two-way planing. Feed of the copy head (at right in photo) is controlled by a profiled templet mounted on the cross bar. The tracer mechanism, built by Heid of Vienna, is electronic, has its vertical feed motion transmitted by a worm-and-nut engagement on the central lead spindle via an electromagnetic clutch.

Variable-rate crossfeed is regulated by the top lead screw through a similar clutch. Relieving tool holder is hydraulic. Bi-directional head (at left in photo) has two opposed tools on individual slides, which are extended alternately by hydraulic rams with each traverse of the table. Constant crossfeed is controlled by the lower lead screw, while vertical feed is controlled by the central spindle when the copy head is disengaged.

Also shown by the East Germans at Leipzig was an inclined eccentric press (Fig. 3) for tin can lids and similar pieces. The press has two triple-action rams that clamp, form and cut out work at rates variable from 150 to 300 strokes per minute, producing twice that number of stampings. Lids drop through the press bed to a double curling machine which rolls the edges, then stacks the lids automatically. Coiled strip is fed in continuously, and punched waste is cut up before ejection.

A crank-type forging press (Fig. 4) is said to be the first machine of its kind ever made by Pels in East Germany. Rated at 2500 tons, the press has a 400-mm stroke and speeds up to 55 per minute. An electric comparator disengages the clutch and stops the motor in the event of overloads. Maximum die width is 1250 mm, and the press weighs 180 tons.

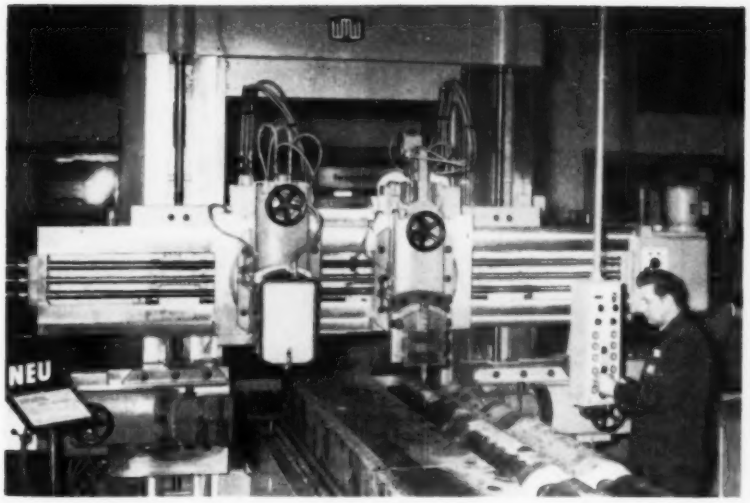
Three-way multi-spindle drill (Fig. 5) shown at Leipzig by the East Germans is designed to drill and bore 22 different kinds of gearboxes for machine tools. As many as 32 spindles can be fitted in various combinations to the machine's universal heads. Cycling is automatic—top and rear slides feed in first, are followed by the side slide when they have retracted.

Fixture with mechanical clamping slides away from the work position for easy loading and unloading. Machine is claimed to cut working time more than 90% of that required by a horizontal borer to machine a typical gearbox.

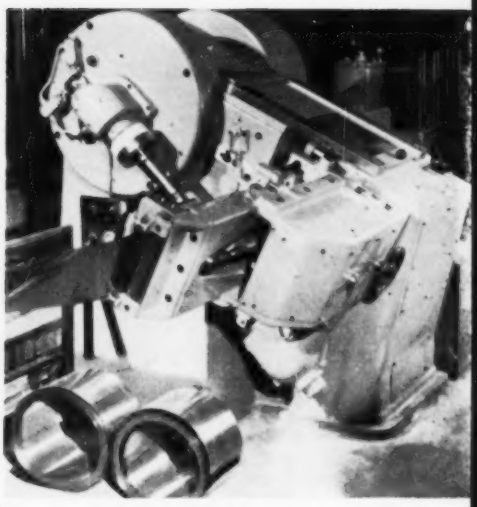
Drum-indexing automatic

Also of interest at Leipzig was an East German drum-indexing automatic, the first of three machines in a setup for producing air-cooled cylinder barrels. Machine's rotary fixture has eight positions with hydraulic clamping, four double-ended work stations, and one unload station.

Machine's operational cycle: (1) rough-bore to two-thirds length from the base end, (2) face head on the other side, (3) rough-bore the top



2 . . . Double-column planer



3 . . . Inclined eccentric press

steal the show at Leipzig

third of the cylinder, (4) machine base spigot, (5) drill four bolt holes from the top, (6) mill two slots in the spigot, and (7) finish machine head and mounting spigot. Demonstration barrels had a 90-mm bore. Cycle time for this machine is three minutes. It is followed on the line by semi-automatics for fine-boring and honing.

Five-sided rotary

A five-sided rotary was tooled up at Leipzig to produce electric motor housings. Machine has four work stations, takes two minutes to cycle, drills three bolt holes in the central shaft hole, then mills the bearing seat, finish-bores the bearing seat, machines the joint recess and face, finish-bores the shaft hole, and chamfers the joint face. All units are standard. Clamping is hydraulic.

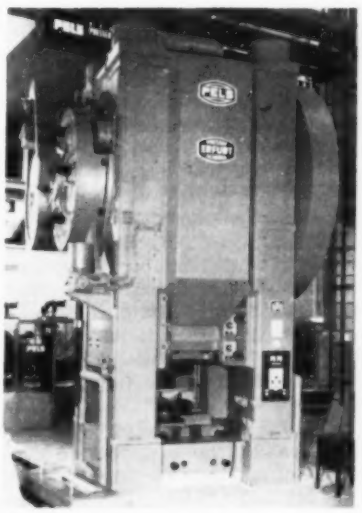
A high-speed gear deburrer on display at Leipzig has a helically profiled grinding wheel coupled to the work spindle through exchange gears —so that both wheels are positively synchronized.

Indexing workhead is double sided, allowing one spindle to be loaded and unloaded while the other is in operation, lending itself to planned automatic loading in the future. New wheels are initially trued by a carbide cutter. After that, shape is maintained by normal grinding. The machine takes gears from 30 to 400-mm diameter, to ±30° helical.

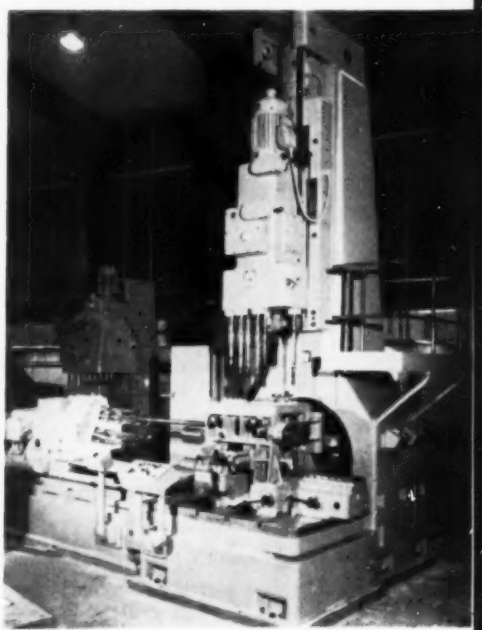
Noteworthy, too, among East German exhibits at Leipzig was a fully enclosed gear shaver for work from 20 to 250-mm diameter that features automatic loading and unloading. Work rolls down an overhead gravity chute into position between the two horizontal centers that move to locate it.

The shaving wheel feeds up from below to engage the gear, then drives it in both directions while cross-traversing. After a predetermined period, the finished gear is kicked forward into the exit chute.

Machine has a simple stacking device that tips the gears to horizontal, then drops them on to one of three vertical dowels that are carried on a small removable turntable.

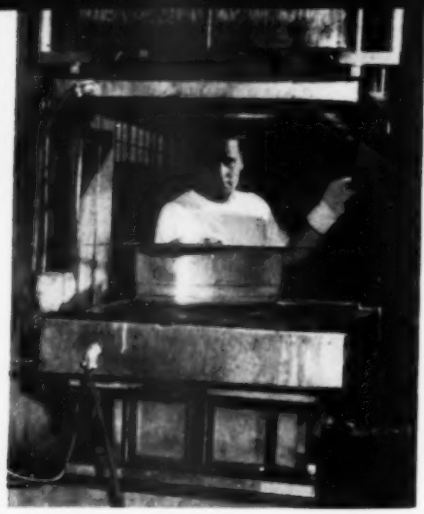


4 . . . Forging press

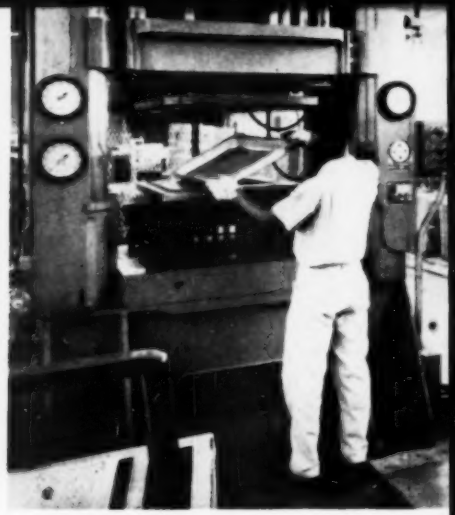


5 . . . Multi-spindle drill

1 . . . Heating tunnels and HPM draw presses



2 . . . Deep drawing of magnesium suitcase shells



3 . . . Shallow drawing of magnesium shells

Hot forming of MAGNESIUM

Two drawn Magnesium Shells and two bent extrusions form basic structure of magnesium suitcases

By Louis R Degen, director of manufacturing, and
Willard Axtell, chief engineer
Shwayder Brothers Inc, Denver

A real boon to the traveler—lighter, stronger and cheaper luggage—is the offshoot of new mass production techniques for hot-forming of magnesium. Luggage made from this lightweight, dent and fracture resistant metal has been on the market for something less than four years, during which time methods of making it have switched from cold to hot forming. Today, Denver's Shwayder Brothers Inc, manufacturer of the Samsonite line, has what is believed to be the largest commercial magnesium hot-forming operation in existence.

First magnesium case in 1955

When magnesium luggage was introduced in 1955 by Shwayder, it consisted of two shallow "U" formed channels of magnesium sheet fitted into magnesium extruded frames, closed on the ends with molded plastic panels. Vinyl plastic was bonded to the metal for protection and decoration.

The only sheet forming operation required for the early design consisted of making two bends to radii of 0.645 and 1.190—sufficiently large to be cold formed. The straight tongue-and-groove extrusions for the top closure required no forming whatsoever.

Success of this original method paved the way for product improvement—the new, better-styled "Silhouette" line—but construction became more difficult. Basic structure of the new line consists of two drawn magnesium shells and two formed tongue-and-groove magnesium extrusions. These parts are formed hot.

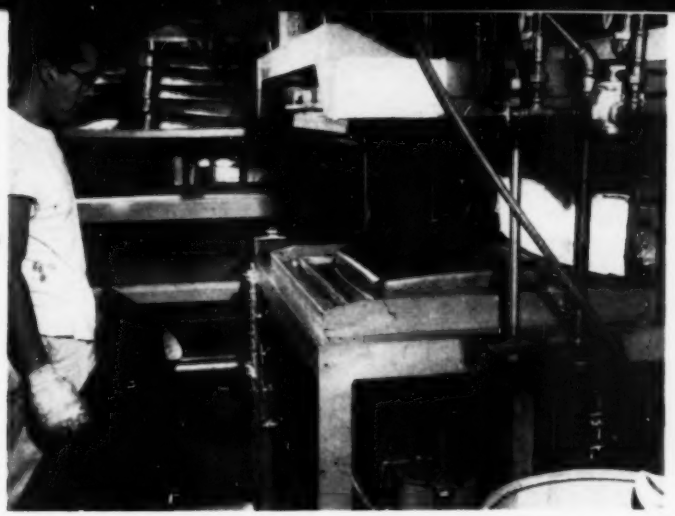
Dow is consultant

Because the usual time cycle for drawing magnesium would not be economically practical, Dow Chemical Co, top U S magnesium producer, was called in to accelerate the operation while keeping springback within tolerances required for high-speed assembly of luggage.

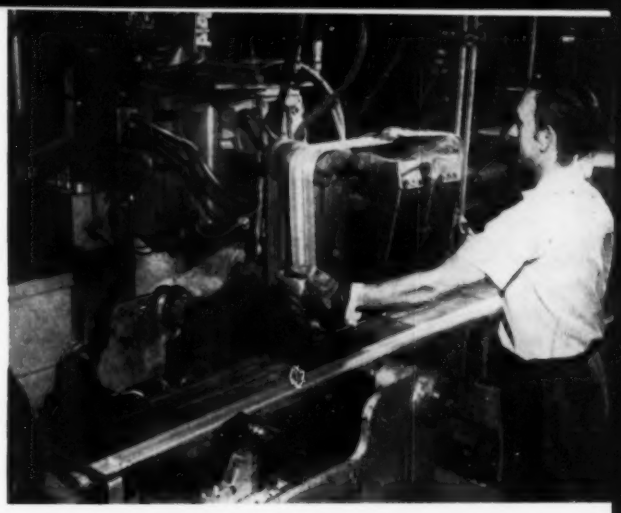
First, coils of unscalped magnesium alloy sheet, slit to required widths at the mill, are uncoiled, flattened and cut to length.

Cut sheets are then fed by hand into a tunnel, where they are heated to about 180 F. Upon emerging, they pass through a Black Bros' coater, where about 2 mils (0.002 in.) of Kerns No. 3833 dry film lubricant is applied at 200 F.

Sheets then go through another tunnel, where the film is dried at about 180 F (this varies with relative humidity from day to day). From the time the sheet enters the first tunnel until it leaves the second requires three to five minutes,



4 . . . Vacuum bonding vinyl sheeting (for protection and decoration) to magnesium shells



5 . . . Bending master extrusions in a bender with electrically heated dies. Pre-heater is at right

moves into high gear

again depending upon relative humidity. Sheets are then stacked to await drawing.

The cold-coated sheet is preheated to approximately 400 F in a platen heater and placed in the draw press. A pressure pad closes on the draw ring ahead of the punch and dwells for five seconds. Temperature of the draw ring and pressure plate ranges from 420 to 460 F; for the punch the range is 350 to 420 F. The pad is not heated.

After the five-second dwell, the draw begins at a rate of 1 fpm. At the end of the draw the press dwells for 11 seconds. For the train case shell (a 6-in.-deep draw completed in a single stroke), total elapsed time (cycle) is 55 seconds: for shells of other suitcases, 35 to 40 seconds.

3000 suitcases a day

Shwayder has installed three HPM triple-action presses to produce 3000 suitcases (6000 shells) a day. One press is rated at 200 tons, the others at 150 tons each. (A press of 75 tons capacity would provide adequate drawing, but the bed wouldn't be big enough.)

Pressures vary with the size and depth of the shell, but they run to about 50 tons on the hold-down ring and 50 tons on the pad, overpowered by about five tons on the punch. With these pressures, and with time of dwell and temperature well established, reject rate is very low (approximately 1%) even for deep draw.

Dies used in this operation are simply constructed from relatively inexpensive hot-rolled plate and shapes. No heat treating is necessary, but because the temperature gradient is steep through the welded-base structure, the mounting plate or feet of the dies are cut through in four places to compensate for the stresses set up in them.

Electrically heated die sets

All of the die sets are electrically heated, are accurately controlled within ±5° of the desired temperature. Electric heating (as opposed to normal gas heating of dies) adds greatly to operator comfort and good housekeeping, is clean and radiates little heat. In recent months, Shwayder has experimented with many types of heating elements, has found that a Chromalox steel sheet cartridge element is most satisfactory.

Shwayder is using 220-volt cartridges with glass-insulated nickel wires. Cartridge wiring is important —normal wiring and insulation simply do not hold up under continuous production. With its Chromalox heater, Shwayder has had no serious trouble with shutdowns or replacements because of element or wire burnout.

Drawn magnesium parts are stacked to retain as much heat as possible, reducing the amount of springback when the flange is removed. Loss of tolerance resulting from flange removal is small.

After this, the magnesium shells are moved to another department, where they are cleaned to remove lubricant, chromated, dried, and sprayed with adhesive. Next, vinyl sheeting is vacuum bonded to the shell and, finally, all holes are punched in one operation.

Extrusions

Magnesium tongue-and-groove extrusions are mated and placed in a small gas-fired oven that accommodates eight pairs of extrusions at a time. Then they're heated to 450 F.

Next, the hot pairs go into a standard Taylor-Winfield duplex tangent bending machine equipped with electrically heated dies. At the start of the bending cycle, the center portion of the extrusion is clamped, then the sides are bent up, and the ends bent together at the top of the dies. Cycle time for this is 20 seconds.

Bent extrusions are next placed in a clamp and sprayed with water to hasten cooling. Because the tolerances needed for the finished part are tighter than the machine is capable of maintaining, the part is end-trimmed to size.

Holes (matching those in the aluminum shell) are punched in the bent extrusions in one operation, then the extrusions are chromated and finished with enamel.

At this point, the extrusions and shells are ready to be joined to each other and to all the other components of the case. And because springback has been kept low and tolerances tight, the parts go together with a gentle tap of a soft mallet.

Inflation factor in new formula proves . . .

Delayed replacement wastes profit

Developers of a new replacement approach at the Jones & Lamson Machine Co, Springfield, Vt, say you'll pay more for machine tools in 1964 or 1969 than today, and lose substantial profits meantime, by following outmoded, arbitrary replacement formulas. To overcome what it considers a serious problem of falsely delayed replacement, the company has worked out an analytical method which introduces the wage-price spiral, inflation, into the replacement calculation.

J&L's treasurer, Norman T Harrison, has put the new formula through a variety of tests and believes it widely applicable to metalworking plant replacement studies. Drawing upon his discussions with management people in various companies, he points out that few of them will disagree that costs will continue to rise in the years ahead, yet none of the replacement formulas now in general use consider inflation in the evaluation.

The Jones & Lamson Formula is a complete package; it has been used in the J & L plant and in surveying customer's equipment investments. Based on avoidable costs, the new technique is more of an evaluation form than a "formula" because no mathematics is required. Data on the present and proposed equipment are collected, compared, and projected. The final figure is the ratio of avoidable cost to the cost of the new equipment. Comparison of ratios for various investments provides a basis for evaluation.

Perhaps of even greater importance than the formula itself, is the arrangement of the evaluation procedure into two parts—analysis and projection. Thus, any company now operating under an established replacement program can, rather simply, continue to use the present method but reevaluate the result in terms of projected rising costs. The difference in return on an investment can be of substantial magnitude.

Presenting a graphic comparison of the costs involved in operating old, obsolete machines as compared with new, efficient equipment, J & L's formula is complete in a simple two-page form. It can help you reach a sound decision, whether you use the entire form or simply the projection.

J&L's new formula cuts through the limitations inherent in many commonly used replacement formulas such as "Rate-of-Return," or "Payoff Period," or "Favorable Cash Flow," which are hazardous to equipment investment evaluation. (*AM*—Oct 20 '58, pM16).

Selection of a particular rate of return, of a specific payoff period, or of a definite period of time required to produce a favorable cash flow, generally, is highly arbitrary.

In some applications, these concepts completely ignore the direct savings which can be made through replacement. Other evaluations overlook the avoidable costs which build up when replacement is postponed to meet an arbitrary, and probably inaccurate, standard.

Of course, you will say that a formula that projects costs ahead by 5 or 10 years also is arbitrary. And you are correct. There is no certain way to *know* the exact cost of labor, materials, or new equipment even five years in the future. However, there is a fairly sound basis for projection in the U S Department of Commerce's Bureau of Labor Statistics reports since World War II.

These tables show a constantly climbing cost pattern which averages, for wages, and for fringe benefits, maintenance, and other material costs, an increase of from 5 to 6% annually. The price pattern for met-

Company - Jones & Lamson Machine Company

MACHINE TOOL REPLACEMENT ANALYSIS

Basic Data

	OLD EQUIPMENT	NEW EQUIPMENT
Name of Machine	4 Engine Lathes Without Bar Equipment (4 operators)	2 Turret Lathes with Hydraulic Drive and Bar Equipment (one operator)
Type, Size, and Horsepower	Ram - 5-2¾ - 7½ HP	Ram - 5-2¾ - 20 HP
Year Manufactured	1939	1959
Year Acquired	1939	1959
Original Cost	$25,464	$54,000
Present Book Value	$ 0	$54,000
Present Market Value	$ 400	$54,000
Estimated Life of Usefulness		15 Years

CURRENT COST COMPARISON (ONE YEAR)

	Avoidable Costs or (Savings)
1. Direct Labor	$15,000.00
2. Indirect Labor	2,000.00
3. Fringe Benefits	4,500.00
4. Spoilage in Manufacture	1,000.00
5. Maintenance - Ordinary	100.00
6. Maintenance - Repair	400.00
7. Power	(600.00)
8. Perishable Tools	
9. Taxes and Insurance	(1,600.00)
10. Depreciation	(3,600.00)
11. Other (List):	
12. Total Avoidable Costs for One Year	$17,200.00

alworking machinery also has increased—about 6 to 7% per year. Few people in the industry anticipate a change in direction for these curves. The trend should be considered in every replacement study.

Some formulas, and managements, think of replacement in terms of "savings." J&L, in its new formula, prefers to consider the "avoidable costs" caused by postponement of a proposed replacement. The difference between savings and avoidable costs is largely one of semantics—but the psychological effect of *avoidable costs* can set an entirely different framework for evaluation.

Most replacement formulas do not provide for projection of costs or savings *over the life of the new equipment.* Nevertheless, the records of any company will show that a machine tool is run at the labor and maintenance rates existing at the time of purchase for only a very small part of its total useful life. Thus, to use only today's labor and material costs is not realistic.

In many instances, these unprojected formulas, together with rigid policies, have prevented the purchase of equipment which would produce savings of 35%, or more, of its installed cost in the first year of operation. Numerical control is an outstanding current example of this problem.

As a demonstration, look at the Favorable Cash Flow concept applied to a $30,000 numerically controlled positioning table having an expected useful life of 10 years: Analysis of the saving, when the table is compared with manual positioning plus drill jigs, shows an advantage of $13,000 in the first year; a cash flow after Federal taxes, plus depreciation, of $9240. The projected annual increase in cash savings after taxes is $1000. *The management objective in this company is a favorable cash flow in two years.* A decision

JONES & LAMSON MACHINE COMPANY

COMPUTATION OF AVOIDABLE COSTS INCURRED BY POSTPONING REPLACEMENT DECISION

	For 1 Year	For 5 Years (3)	For 10 Years (3)
Avoidable Costs From Current Cost Comparison (Line 12 - opposite page)	$17,200	$ 17,200	$ 17,200
Avoidable Costs From Current Cost Comparison $17,200 times number of years		86,000	172,000
Factor for Projected Increase In Labor and Material Cost			
$17,200 times 27.63% (1)		4,752.36	--
$17,200 times 62.90% (1)		--	10,818.80
Factor for Projected Increase in Cost of New Equipment			
$54,000 times 38.0% (2)		20,520.00	--
$54,000 times 76.3% (2)		--	41,202.00
Total Avoidable Costs Incurred	$17,200	$128,472.36	$241,220.80

(1) Obtain percentages from "Projection of Wage and Material Cost Factors"

(2) Obtain percentages from "Projection of Replacement Cost Factors For Metal Working Machinery"

(3) Beyond First Year

Basis For Rating One Replacement Project Against Another

Proposed Investment In New Equipment	$ 54,000	$ 54,000	$ 54,000
Ratio of Avoidable Costs To Cost of New Equipment	31.9%	237.9%	446.7%

PROJECTION OF WAGE & MATERIAL COST FACTORS

Year	For Year	Cumulative
Current Year	0	0
1	5.00%	5.00%
2	5.25%	10.25%
3	5.51%	15.76%
4	5.79%	21.55%
5	6.08%	27.63%
6	6.38%	34.01%
7	6.70%	40.71%
8	7.04%	47.75%
9	7.39%	55.14%
10	7.76%	62.90%

INSTRUCTIONS

Apply the cumulative ratio (opposite the number of years, beyond the first year, for which a replacement decision would normally be postponed) to the net of the figures in the Current Cost Comparison (for one year) on the first page of the form. Enter the projected cost at Line 12, and on page two of the form.

PROJECTION OF REPLACEMENT COST FACTORS FOR METAL WORKING MACHINERY

Year	Actual Replacement Cost Factor	Replacement Cost Factor - Arithmetical Average
Current	0	0
1	1.052	1.076
2	1.122	1.152
3	1.278	1.228
4	1.342	1.304
5	1.364	1.380
6	1.382	1.457
7	1.449	1.533
8	1.553	1.610
9	1.708	1.686
10	1.763	1.763

INSTRUCTIONS

Multiply today's cost by the Replacement Cost Factor for the number of years, beyond the first year, you would normally postpone replacement. Thus, if normal replacement is postponed for five years the Replacement Cost Factor is 1.382. At a cost today of $54,000, the cost in five years will be $74,628—an additional cost of $20,628. Projections are based on past price pattern for Metalworking Machinery developed by US Dept of Labor, Bureau of Labor Statistics.

Delayed replacement . . .

is made to postpone the purchase three years.

Here is the result:

Loss of cash—

First year	$ 9240
Second year	$10,240
Third year	$11,240
TOTAL	$30,720

And here is the hidden secondary result:

Projected cost of equipment in 3 years—$37,000

Postpone replacement for approximately 4 more years.

And the equipment is never a practical purchase even though nearly $100,000 will have been lost by not having it in the shop; nothwithstanding that it offered a 20% after-tax return on the initial investment.

This is the price of arbitrary periods for recovery or returns.

Favorable cash flow evaluation differs from the Payoff method only in that the investment in new equipment is, in effect, debited in the equation. Dollars returned by savings, or cost reduction plus depreciation (which does not represent a cash outlay), are credited with the resulting time shown to recover the original investment. As with the Payoff Period approach, selection of the number of years required to obtain a favorable cash flow is, again, an arbitrary "exercise in mysticism." Similarly, it completely ignores the avoidable costs which will be incurred by postponing the replacement decision.

Recently, George Terborgh, Research Director of the Machinery and Allied Products Institute (MAPI) developed a new concept of equipment investment to replace the earlier MAPI formula. It is based on the one-more-year analysis of the replacement problem. It measures the urgency of a replacement project, in relation to all other investment possibilities, as compared with going on without the proposed equipment for *one more year*.

As a result of thorough, careful study, Mr Terborgh assumed in developing the MAPI formula that the return on an investment, relative to deferment of the investment, rises as the proposed period of deferment is extended. Thus, the next full year of deferment offers the minimum return and further deferment can only increase the urgency.

Mr Terborgh rejected ranking a project by the absolute return over the life of the equipment because: 1. It cannot be estimated for most projects. 2. It misranks most projects for which it can be estimated.

Ranking by relative return, on the other hand, raises the question of which relative return to use; of which period of deferment to assume. Analysis of various periods of deferment showed that the most practical approach to replacement is to estimate the minimum relative return.

This technique, many companies are finding, is extremely practical. Even companies using Favorable Cash Flow and Payoff Period formulas now start with the one-more-year premise. It minimizes long-range, abstract predictions and works with readily obtainable figures.

However, in seeking a formula for use by J&L, Mr Harrison suggested that the MAPI Formula would be more suitable than at present if broader predictions or projections were made in using it; that a decision had to include some sound indication of inflationary influences.

He recommended using, rather than today's labor and fringe benefit rates, an average rate over the foreseeable useful life of the equipment, plus a factor for the rising cost of capital equipment. As a result of this study, the simplified Jones & Lamson Formula was developed.

Projection tables used with the formula are not, of course, precise. They are, instead a projection of the best available indices of past trends. If more accurate projections are available for a specific situation, J&L suggests these be used. For companies having long-term (3 or 5 yr) wage and fringe-benefit agreements with contractual increases during the contract period, it is possible to make *actual* projections for this period of time.

Any replacement formula must have a device for rating each replacement project against all of the other projects with which it is competing for capital. This rating is provided on the second page of the J&L Formula as the ratio of avoidable costs to the cost of the proposed equipment.

The ratio should be established for several periods of years. It is possible that, while a particular project may show the highest ratio for one year, in another period of years the situation would be entirely reversed in favor of another project. Comparing these ratios, then, provides management with a sound basis for short- and long-term evaluations.

Theoretically, a difference of one dollar of avoidable cost makes replacement practical, but the decision isn't that simple. Many other factors must be considered, such as the anticipated service life of the proposed equipment and its chances of deterioration and obsolescence. Will a new process cut short its value? Also, you must evaluate the effect on floor space, inventory turnover, materials handling, downtime, employee skills, and the elimination of safety hazards. These factors are equally important with the elements in the formal analysis. Select the investment which gives you the best overall return on your dollars; which avoids the largest cost. Jones & Lamson believes that the new formula can help you.

Shop man's "Operations Research"

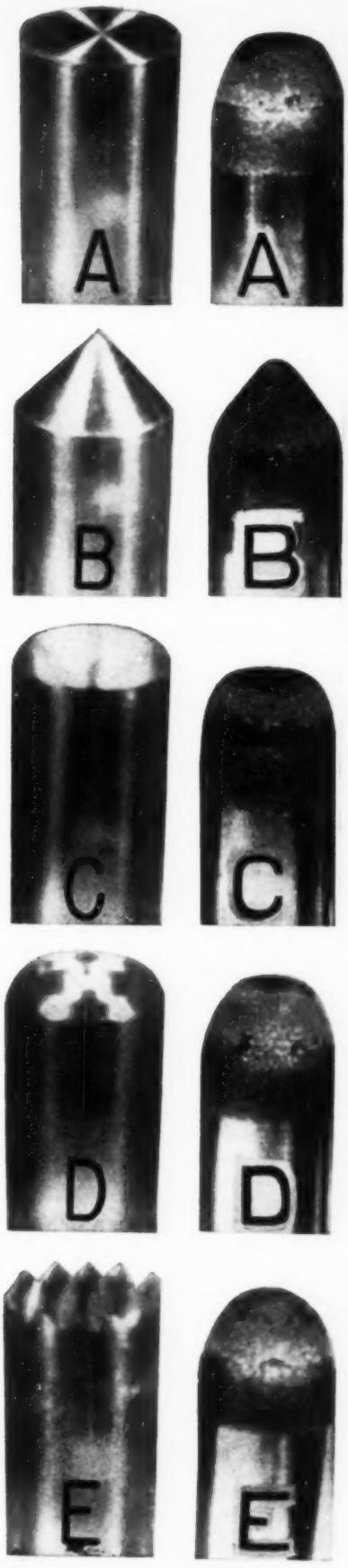
While not actually "Operations Research," Methods Engineering people on General Motors' Process Development Staff follow a procedure in attacking a problem that contains many of the benefits of the more complex OR technique. As described by Harry D Hall, of the staff, at the SAE National Aeronautic Meeting in New York, manufacturing problems are studied by a Planning Team. The team usually comprises two men from the Process Development Staff and two men from among the Divisional personnel. The team works to a formal plan of attack called the "Methods Engineering Approach."

In the MEA a problem is studied in seven steps:

1. Determine problems or objective
2. Study conditions
3. Plan possible solutions
4. Evaluate possible solutions
5. Recommend action
6. Follow up to assure action
7. Check results

Thirty-four studies completed to date have been extremely varied. A tabulation of directly measurable results shows a good return on investment in every case. One of the more outstanding jobs shows savings of 11 times the investment, with the average ratio better than three to one.

Most of the mathematics used in these studies is elementary; far from the complexity of true Operations Research. Nevertheless, Mr Hall says, this method is getting things done until computers are more commonplace in shops. And the return is well worth the effort.



In electric-discharge machining...

What's the best electrode shape for removing metal?

By Richard W McDowell, graduate school of industrial engineering, and Orville D Lascoe, professor of industrial engineering, Purdue University

What effect does electrode shape have on metal removal rate? Extensive tests made at Purdue University show that of five shapes—flat end, 90° point, inverted (funnel shape) 90° point, circular serrations, and straight serrations—the 90° point is superior because of its particle-evacuation abilities.

However, because each job must be tailored to suit specific applications, the tool designer must have at his disposal information that will enable him to find these facts without costly experimentation.

On the subject of electrode design, much time can be saved if something is known of the action electrodes have on metals. The prime objective of the tests was, therefore, to establish the relationship between electrode shape and metal-removal rate. With this in mind, five types of electrodes, with the contact areas mentioned, were machined. The total volume of metal removed, and the ability of each to evacuate particles produced was closely recorded.

Electrode design

In electrode design, it must be remembered that an electrode must be smaller than the hole desired in the workpiece. This dimensional difference depends on the spark gap which is controlled by the machine setting, tool material, and work material.

An electrode must also be long enough to compensate for linear wear. For through holes, ⅛-in. dia or more, the length should be 1 to 1½ times the depth of the hole. For holes smaller than ⅛ in., the electrode should be 4½ to 7½ times the hole depth.

Electrodes can be made as a single unit or as a composite of several sections, either solid or hollow. The single unit is better where a high degree of accuracy is required. The composite tool is good for large sections where solid tools would be too expensive.

Electrode material

The material from which an electrode is made will influence the metal removal rate as well as the surface finish. The effect of heat on the workpiece and tool is of major importance, while hardness and other physical properties of the electrode materials are relatively insignificant.

The size of the particles removed will vary with the electrode material, even though the discharges are of identical energy. That is to say, the surface finish can be different under the same machining conditions.

For example: Tests showed that machining steel with a brass tool produced a surface finish of 200 mu-in. Under the same machining conditions using a copper-graphite tool, the surface finish obtained was 300 mu-in., but the production rate was higher. Thus, metals that are more machineable with this process will have a rougher surface finish than metals less machineable.

Because the function of the tool in spark machining is to direct discharges to a specified area of the work, qualities of the tool are determined by the thermal and electrical-conductivity characteristics of the material from which it is made.

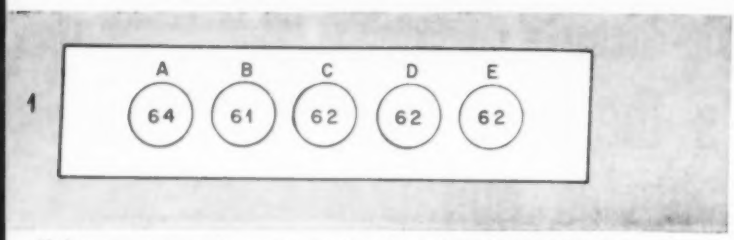
Electrode wear

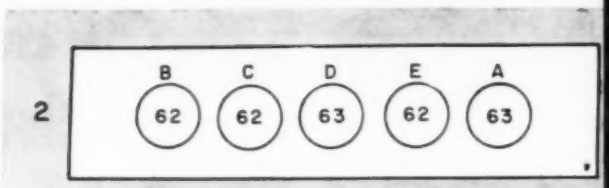
Wear of the electrode can vary betewen 20 and 250% of the volume of metal removed from the work, depending on the machining conditions and the material from which the workpiece and electrode are made. In practice, however, tool wear can be reduced by varying the discharge-circuit resistance, lowering the power input, selecting a more erosion-resistance material, or altering the shape of the tool.

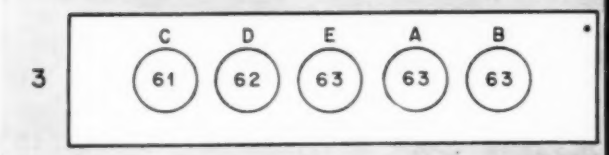
Working fluids

Discharge machining is generally performed submerged in a dielectric

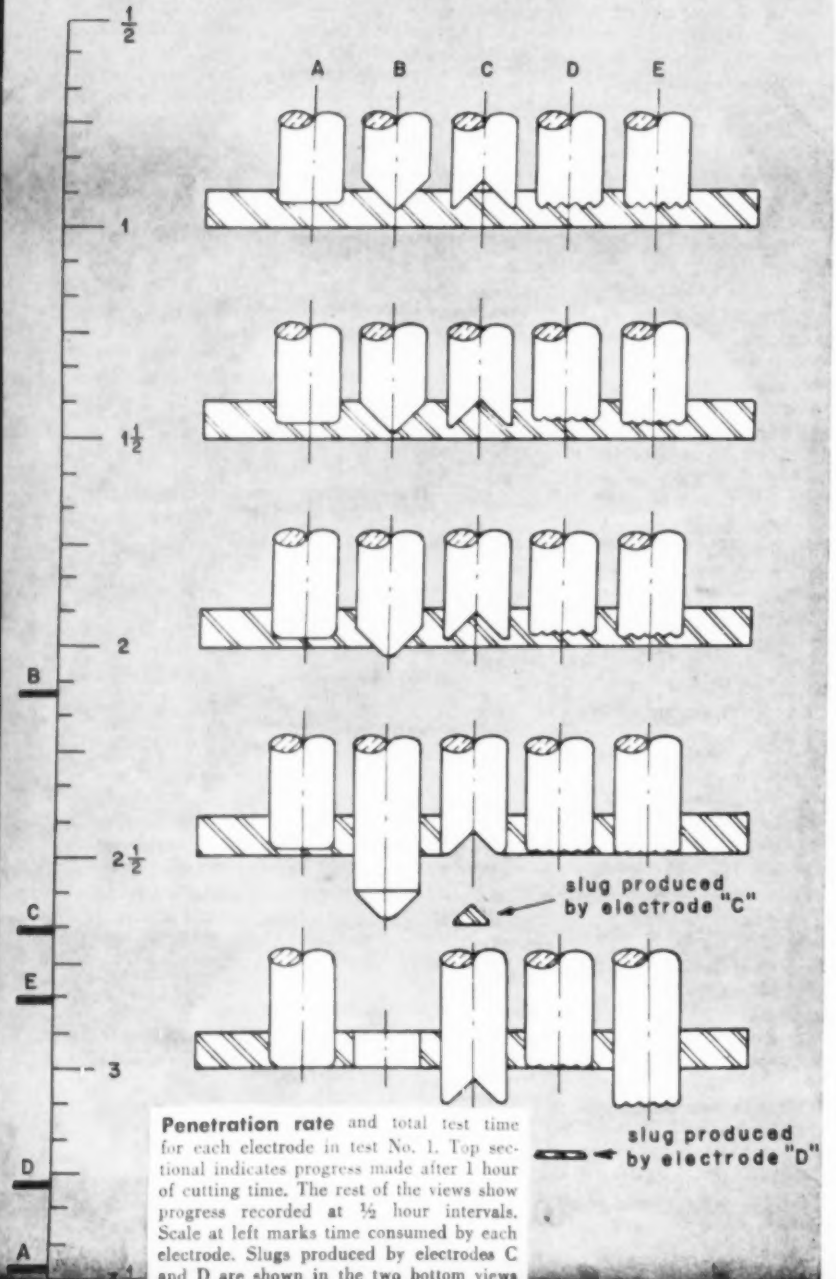
Electrodes are shown as they appeared before and after test. Column at left illustrates how each was machined. A has flat end, B a 90° conical point, C an inverted 90° cone, D circular serrations, and E straight serrations. After each had cut five holes, it appeared that B retained its original shape better than the rest







Hole arrangement was staggered to place electrodes at different locations on each sample. These positions, placed at 1¼ in. center-to-center distances, were lettered on all samples as shown. Rc hardness tests were taken at all positions and the average for each recorded



Penetration rate and total test time for each electrode in test No. 1. Top sectional indicates progress made after 1 hour of cutting time. The rest of the views show progress recorded at ½ hour intervals. Scale at left marks time consumed by each electrode. Slugs produced by electrodes C and D are shown in the two bottom views

fluid to prevent particles from sticking to the tool and to dissipate them from the working area, thereby increasing the speed of the process. Best results can be obtained with organic liquids such as kerosene, transformer oil, or mineral oil. Water can also be used, but its high conductivity results in incomplete charging of tbe condenser in the electrical circuit, hence, production is low.

Surface finish

Electrical - discharge machining produces a surface different from that obtained by mechanical means. Each discharge pulls a particle from the surface of the part, leaving a concave depression which is up to 0.3 times as deep as its diameter. During machining, the work surface becomes covered by a multitude of these depressions, overlapping each other thereby producing a matte finish.

Surface finishes are determined by the same methods employed to find the finish of mechanical metal-removal processes. Rough, or semi-finished, surfaces are inspected with a binocular microscope. A Profilometer, Surfindicator, or Interferometer is used for checking finished surfaces.

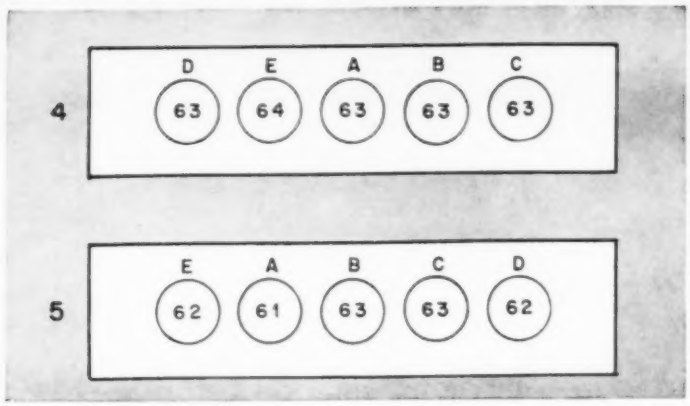
Metal removal rate

The metal removal rate is low in electrical-discharge machining, the maximum being approximately 0.02 cu in. per min. It has been established that 99.3% of the cycle is required for charging and discharging the condensers, allowing only 0.7 for actual work.

Machining time would be greatly reduced if the time between charges could be decreased. [A new Japanese-developed machine has made significant progress toward this goal, the report of which appeared in AM —Dec 29 '58, p56. Ed]

Test preparations

The electrical-discharge machine



employed was an Eleroda D1 which has an electrode-shank-diameter capacity of 0.865 in. The table, with a micrometer adjustment for both traverse and cross feed, gave us a maximum movement of 11 and 7 in. respectively. Automatic down feed of the electrode was attained with an electro-hydraulic servo-mechanism which is an integral part of the machine.

Plans were to machine 5 holes in each of 5 workpieces or a total of 25 holes. All electrodes were machined from Revere 1-in. dia, 100 Mix electrolytic tough-pitch copper. Their over-all length was 6 in. of which 2 in. were turned down to 0.865 in. to fit the electrode holder.

The contact end of the first was faced off flat and marked A. The next, called B, was turned with a 90° point, whereas C received a funnel-shaped or inverted 90° point. Serrations were tried on the last two. Electrode D got circular serrations while E was serrated straight across.

To obtain the utmost in uniformity, with respect to hardness and grain structure as well as dimensional accuracy, the work samples were cut from the same strip of steel. Stentor tool steel, with a carbon content of 0.90%, manganese 1.60%, and silicon of 0.25% was used. The samples were finish machined to ½ x 2 x 8 in. and given the following heat treatment.

Placed in the furnace, the pieces were slowly brought up to a temperature of 1200° F and held for ½ hour, then increased to 1460° F. After ½ hour of exposure to this temperature, the samples were quenched in oil. To overcome warpage and stress, 0.010 in. was ground off both sides of each piece.

Kerosene was selected as the dielectric fluid and a constant level was maintained throughout the test. After continuous machining, the dielectric fluid became contaminated, but a filtering system could eliminate this condition.

Machining procedure

The machine controls were set and maintained for optimum cutting action so each electrode could be judged on its own merit. This was achieved by regulating the power and feed controls to hold a steady indicator reading of the gap stabilizer. With controls properly adjusted, a steady sizzling sound at the electrode will accompany good cutting action.

Power setting and depth of penetration were recorded at the end of each hour of operating time. Electrodes A, C, D, and E were allowed to overtravel ½ in. after breakthrough, whereas electrode B was allowed 1 in. because of the ½ in. of travel necessary to reach full diameter.

Inspection and results

An optical comparator checked electrode wear to record changes in shape between each run. Photo illustrates the five electrodes before and after machining. Slugs produced by electrodes C and D were weighed on a Voland analytical balance to establish their volume. These were subtacted from the total volume of their respective holes to compute the metal removal rate.

The holes were projected ten-times size on the optical comparator as a check for roundness. In each case, the hole was found to be within 0.001 in. of the radius. Dimensions at top and bottom of each hole were measured with a tool maker's microscope the results of which are listed in chart.

A study of this data revealed that electrode B performed better than the others in all five tests. The superiority of this electrode proved that its design allowed better evacuation of particles throughout the cutting process. This can be attributed to a smaller contact area between electrode and work as compared to the other electrodes. Particle evacuation was further aided by the point of the tool penetrating the bottom of the work.

The rest of the electrodes took on a relatively identical shape as the test progressed, and their metal removing rates were much the same. Electrode C required the longest time, the reason for this being its poor evacuation ability.

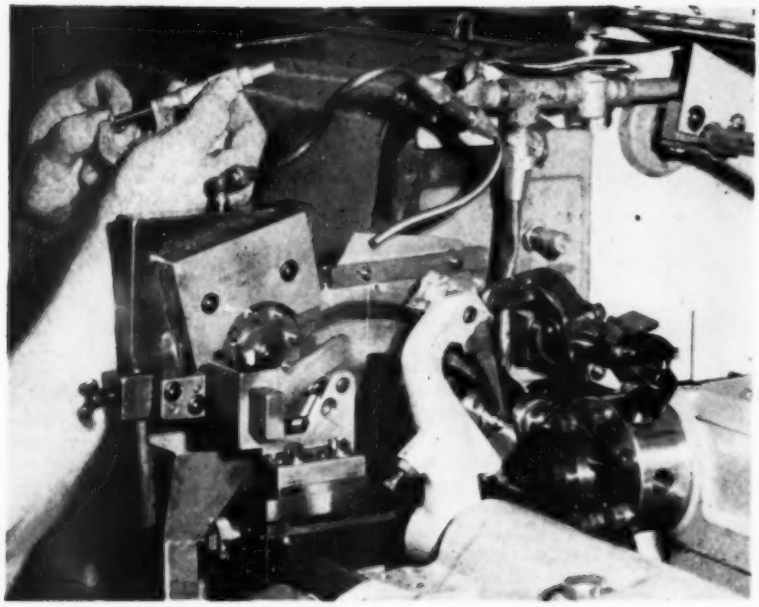
With good evacuation, the power on the electrode can be increased. And with an increase in power, the production rate goes up.

This article is based upon a M S thesis submitted to Purdue University. Some of the material for this discussion was gathered in a survey of articles published by the following technical magazines:

"Arch Machining Makes Hard Jobs Easy" by H V Harding and V E Matulaitis, American Machinist—March 3, '52, p136
"Electrical Discharge Machining" by H V Harding, V E Matulaitis and R C Stoke, American Machinist—March 15, '54, p137
"Electrical Discharge Diesinker" by George L Weiser, American Machinist—Oct 10, '55, p148
"How to Understand Spark Erosion" by R Decat, American Machinist—April 23, '56, p113
"Fundamentals of Electrical Discharge Machining" from Russian paper, Machinery—May '56, p139 concluded June '56, p169
"Form Tool by Electrical Discharge Machining" by N C Cici, Machinery—July '56, p148
"Spark Erosion Behind the Iron Curtain" by E Gros, American Machinist—July 30, '56
"Electrical Discharge Grinding of Tools" by V E Matulaitis, The Tool Engineer—Aug '56, p97
"Russians Discover Spark Cutting," Metal Progress—Jan '57, p121
"Electrical Discharge, Shapes, Tools and Honeycomb" by Thomas A Dickerson, American Machinist—June 3, '57, p102
"Electrical Discharge Cuts Impossible Slits" by E J Lach and Carl Munter, American Machinist—Aug 12, '57, p105
"Electrical Discharge Machining" by E N Baldwin and B W Nieble, Designing for Production—'57, p426
"Electrolytic Grinding Tames Hard Metals" by Lynn A Williams, The Tool Engineer—Aug '57, p96
"In Plant Diamond Mines are Expensive. Spot Yours and Save" by Carol E Reuss, Tooling & Production—Feb '58, p67
"Electro-Erosion Technologie" Charmilles Ateliers Des Charmilles, S A Geneve

Screw machine is a broach, too

By Forest McDaniel, product engineer, Western Electric Co, Cicero, Ill



Broaching fixture . . . works automatically along with screw-machine action. Pickoff arm delivers parts; cross-slide action powers the dial

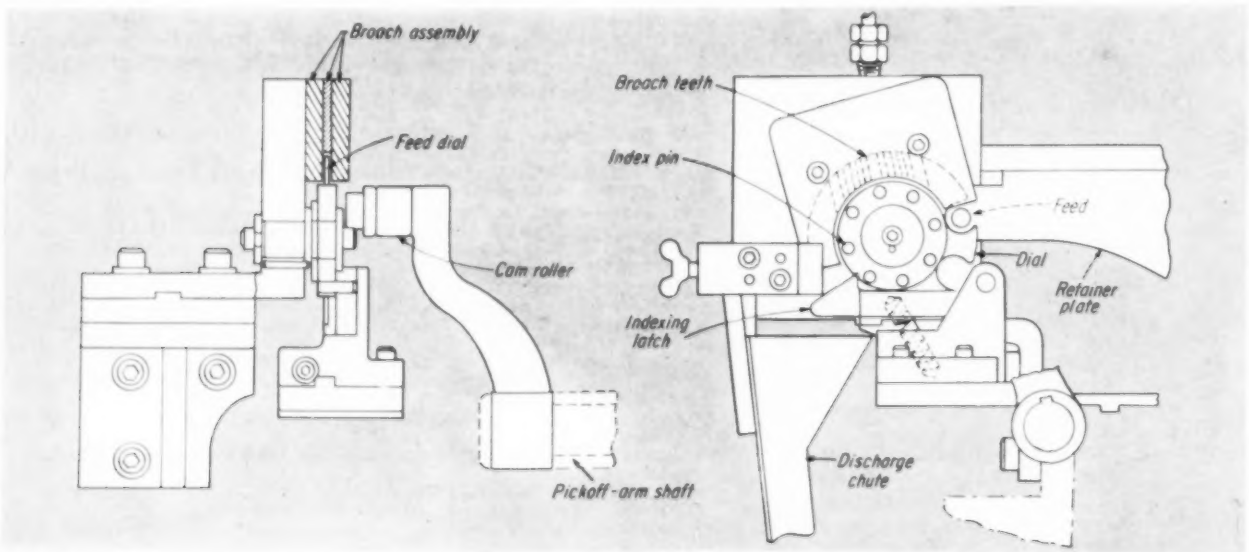
One machine works like two at Western Electric's Hawthorne plant, where a broaching fixture on a Brown & Sharpe 00G screw machine saves an extra operation. The reason for broaching is to hold tolerances of ±0.0005 in. on the thickness of small spacer rings that go into crossbar equipment for dial-telephone central offices.

Regular screw-machine tools cut the rings from aluminum-alloy rods, to produce parts with a 5/16-in. OD and 0.196-in. ID. Thicknesses are either 0.072 or 0.081 in. When the screw-machine cycle is complete, the regular pickoff arm transfers each ring to the broach fixture, where final dimensions and flatness are produced.

Action of the cross-slide and pickoff arm indexes the part-holding feed dial to produce intermittent motion of the parts past 15 broaching teeth. Ten teeth take cuts 0.0005 in. deep each, and the five final teeth do the finishing. Parts drop through a chute to a tote pan after they have been ejected by a spring-loaded pin in the fixture.

The feed dial is controlled by index pins to move the work between the HSS broaching tool and a hardened backup plate. The two plates are separated by a spacer plate, which is machined 0.001-0.002 in. undersize but is bowed so tightening the adjusting screws sets the exact final broached dimension required.

Broaching and backup plates can be reground, then reassembled with the spacer plate plus shims to bring dimensions back to requirements.



Pickoff arm brings up parts . . . to broach fixture along retainer plate. Cam attachment strikes bar on fixture (see photo) to index dial and operate latch. Parts are broached across one end to bring them to exact length requirement

American Machinist completes survey of

Foreign machine tools in U. S. metalworking

AMERICAN MACHINIST PRODUCTION EQUIPMENT SURVEY – 1959

1. Do you have foreign machine tools (cutting or forming) in your plant now? Yes ☐ No ☐ If yes, how many? _____
   (If no, please skip to question 5.)

2. Please list here the foreign machines you now have, giving the size, country of manufacture, and year bought. Two sample entries are given to show the kind of information desired:

	Quantity	Size and Type	Country	Year Bought	Used for (check one) Production	Maintenance
sample entries	2	3-ft radial drills	England	1955	✓	
	1	16-in. engine lathe	Germany	1956		✓

3. Please check the statement that most nearly describes the principal reason for the purchase of foreign machines:
   - ☐ Characteristics and capacity equivalent to U.S. machines and price was lower
   - ☐ Characteristics and capacity adequate though below U.S. machines but price was lower
   - ☐ Characteristics and capacity superior to U.S. machines
   - ☐ Unique performance characteristics not available in U.S. machines
   - ☐ Needed quick delivery and could get it in foreign machine
   - ☐ Other (please explain) _____

4. Have you in general been satisfied with the quality of your foreign machines? Yes ☐ No ☐
   Have you needed parts or services? Yes ☐ No ☐
   Has service been satisfactory? Yes ☐ No ☐
   Have parts been readily available? Yes ☐ No ☐

5. Do you plan to buy machine tools during 1959? Yes ☐ No ☐
   If yes, how many? _____ How many of these do you think will be foreign machines? _____

6. About how much do you expect to spend for new machine tools in 1959? _____
   How much of this will probably be for foreign machines? _____

Why the survey–

No reliable information has been available as to 1) how widely foreign machine tools are used in U S plants, 2) whether one part of the country, like the West Coast, has more of them than another, 3) whether one metalworking industry, such as farm machinery makers, has more of them than another, 4) whether there are more foreign machines in small shops than in big plants, 5) what the main reasons have been for buying foreign machines.

How the survey was made–

To get this information, American Machinist mailed a simple one-page questionnaire to more than 5000 plants that had supplied complete data for the 1958 American Machinist Inventory of Metalworking Equipment. The response was extraordinary. 2722 plants filled out and sent back their questionnaires—better than a 50% return. Analysis of the returns shows that the plants are well distributed in size, geographic location and kinds of metal products made. These 2722 plants have work forces representing 9.5% of the total number of employees in all of U S Metalworking.

For detailed answers to the questions from 2722 plants, please turn to next page ➧

AMERICAN MACHINIST EDITORIAL RESEARCH REPORT

No. 471
April 20, 1959

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330 W 42nd ST, NY 36, NY

AMERICAN MACHINIST EDITORIAL RESEARCH REPORT

Foreign machine tools in US metalworking . . .

1. Do you have foreign machine tools in your plant?

Of the plants that responded to this survey, one out of every four has foreign-built machine tools. Here's the breakdown on this question:

- 2722 plants, with 9.5% of the wage earners in Metalworking, provided data
- 737 plants (27%) have one or more foreign machine tools
- These plants reported a total of 2292 machines
- 1985 plants (73%) don't have them

Average number of foreign machines in plants that have them is 3.1. Average for all plants, including those that answered "No," is 0.8. According to the latest American Machinist Inventory (Nov '58), the average U S metalworking plant with more than 20 wage earners has approximately 90 machine tools, both foreign and domestic.

The relationship of machines to employees is consistent with the machines-per-plant ratio. This survey reveals a total of 4.1 foreign machines per 1000 wage earners. The Inventory shows 368 machine tools (both foreign and domestic) for every 1000 wage earners employed.

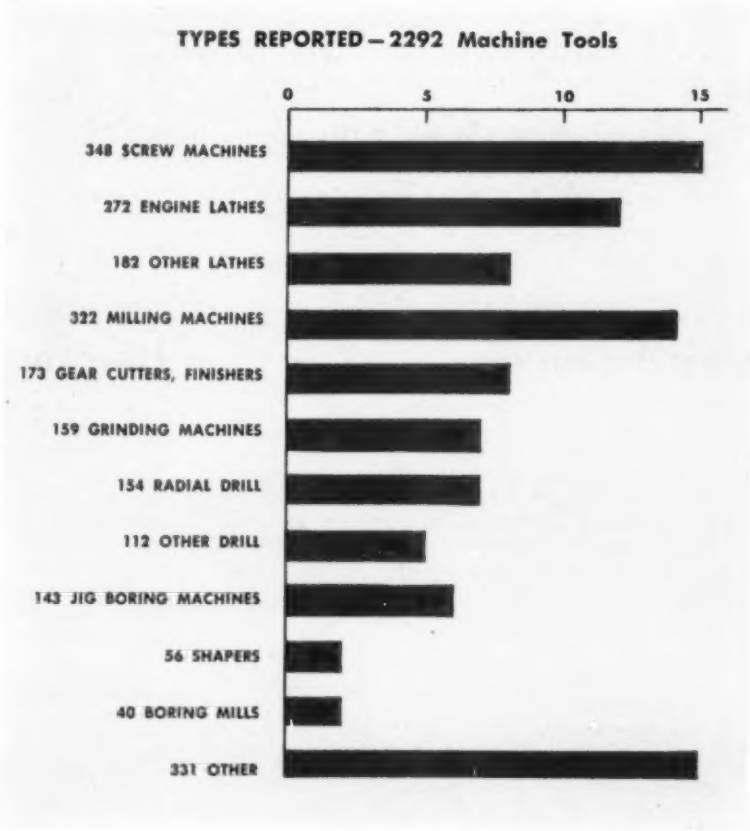
This American Machinist survey does not pretend to be anything other than exactly what it is: A fact-finding study of foreign machine tools in the 2722 plants supplying information. The editors believe that it sets a pattern that, because of the cross-section accuracy of the survey, probably would not be changed much if a complete plant-by-plant count were made. At the same time, the editors are not attempting to expand the actual data to include all of Metalworking.

2a. What types of foreign machines do you have?

The chart on the right shows what foreign machine tools were reported, and the percent of the total (2292 machines) for each machine type. Eleven machine types are listed in the chart, as well as a twelfth category, "Other," that includes types not reported in large-enough numbers to be significant. Figures for all forming-type machine tools appear in the "Other" total, in addition to cutting types not listed.

How does the percent for each machine type in the sample compare with that for each type in all of Metalworking? According to the American Machinist Inventory, there are 2,218,000 metal-cutting and metal-forming machine tools (both domestic and foreign) in U S metalworking plants. Here is the percentage of this total for each machine type:

Screw machines: 3%
Engine lathes: 6%
Other lathes: 7%
Radial drills: 2%
Other drills: 14%
Boring mills: 2%
Milling machines: 8%
Grinding machines: 16%
Gear cutters and finishers: 2%
Shapers: 2%
Jig borers: 0.4%
Other: 37.6%



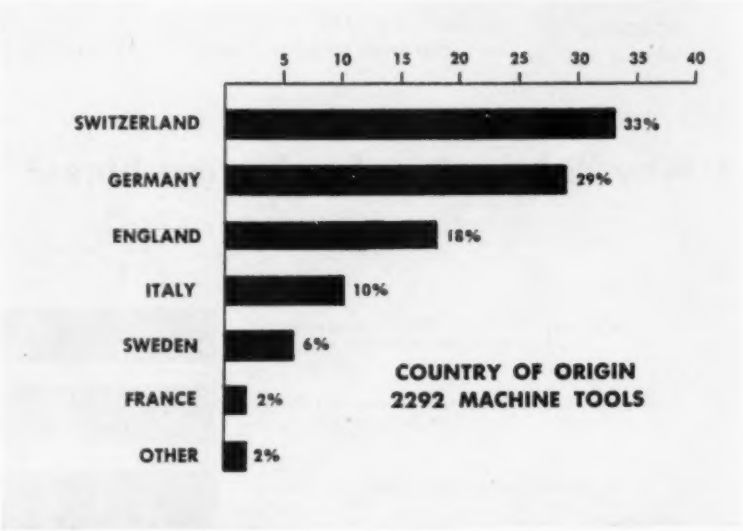
SOURCE: American Machinist

2b. From what countries were your machines imported?

As the chart to the right shows, 98% of reported machines were built in six European countries. The remaining 2%, listed under "Other," represents machines built in several other nations, of which Belgium and Denmark are the most significant.

There is a definite relationship between machine type and country of origin. Certain machine-tool builders in some countries have long been familiar names to the buyer of foreign machine tools. The country-of-origin chart and the machine-type chart on the opposite page are closely related tables.

In this survey, no attempt was made to collect data on who built the machines. Nor was there an effort to relate date of purchase to country of origin. Such statistics, although interesting, fall outside the scope of the survey.



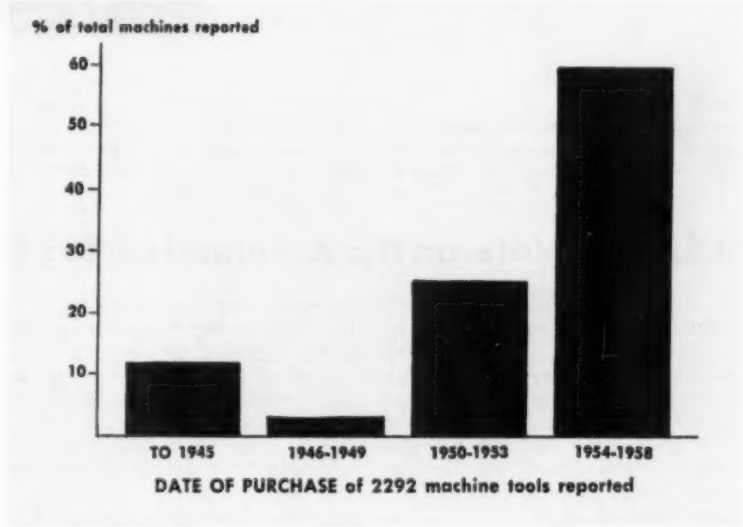
SOURCE: American Machinist

2c. When did you buy your foreign machines?

Of the 2292 foreign machines reported, 60% have been bought in the past five years, 85% since 1950. The date-of-purchase chart to the right follows the 4- or 5-year intervals that recent American Machinist Inventories have covered.

Some 12% of these machines were bought before the end of World War II; almost all of these are over-20-years-old machines purchased in the 1930's. A much smaller portion of the total (3%) was bought during post-war years (1946-49), when European machine tools were not exported in large numbers.

It is safe to assume that date of purchase for most of the machines approximates year of manufacture. A few plants, however, reported purchases of used and military-surplus machine tools.



SOURCE: American Machinist

2d. For what purpose are your machines used?

Most of the machines reported are in the production lines of the plants that own them. Almost nine out of ten (88%) are used for production, only 12% for maintenance. A very few plants reported using a machine both for production and for maintenance. A handful of plants wrote in that the machine is used for tool-room work; it was then included in all tabulations under "Production."

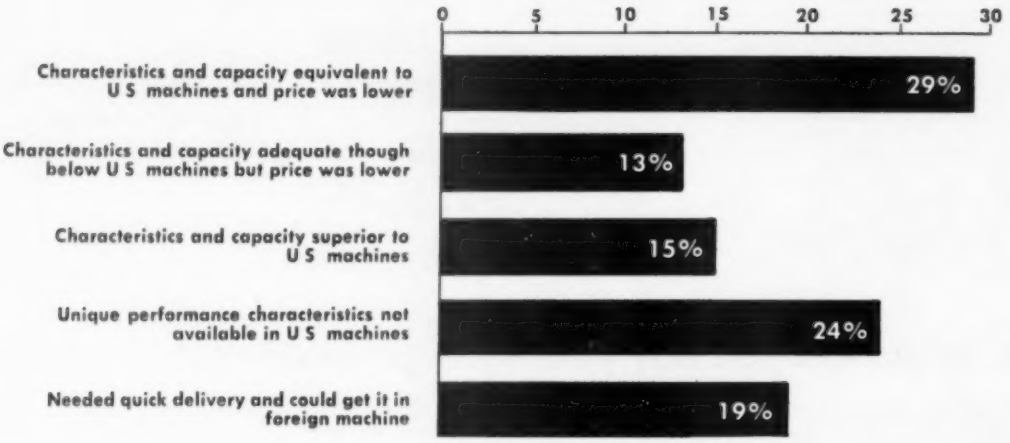
With one exception, this large ratio in favor of production holds true for the individual industry groups within the sample, as well as for the total. Only in the Ordnance-Shipbuilding-Railway industry is production use less than maintenance—45%.

For some of the industry groups that appear in the chart on page 141, here are some examples from the sample of this ratio (production percentage given only): Special-Industry Machinery (100%); Aircraft & Parts (98%); Forge Shops, Foundries, Miscellaneous (96%); Metalworking Machinery (96%); Communications Equipment (86%); Farm Machinery (73%); Office & Service Machines (68%).

AMERICAN MACHINIST EDITORIAL RESEARCH REPORT

Foreign machine tools in US metalworking . . .

3. Why did you buy foreign machines?



SOURCE: American Machinist

Each of the bars . . . in the above chart represents the percentage of total answers to this question. This total does not agree exactly with the total number of plants reported, because a plant with more than one foreign machine could have more than one reason for buying its machines. Plants were asked to check one or more of six reasons for buying the machines. In the sixth reason ("Other"), write-in replies were so scarce and so varied that no significant additional reason developed.

A Special Note on the Automotive 'Big Three'

No attempt was made to get the individual manufacturing plants of the automotive Big Three to fill out questionnaires. Instead a staff editor of American Machinist called personally on key production executives of each of the Big Three companies—General Motors, Ford and Chrysler—and brought back these facts and impressions:

Very few foreign machines are used on automobile production lines. More than that, automobile companies possess only relatively few foreign machines, most of which were purchased for toolroom purposes. One of the Big Three reports that its sole imported machine now in use is a spark-erosion machine in its experimental department. This auto maker says further that it is "not in the market for foreign machine tools of any kind."

Two of the Big Three stressed that imported machines are bought on the basis of performance only, with price not being the deciding factor. These machines must have advantages not available in U. S. machines. Even then they are not ordered unless they are "especially useful for the purposes needed." One Big Three division executive expressed the opinion that his division does not have any production machines from abroad because his staff has no particular feelings either for or against such machines. Time and again the point was stressed that imported machines must have something special to offer if they are to be considered at all. Some foreign toolroom equipment was cited as having the kind of special features that make them worthy of consideration. Automotive people reiterated that the factors that they are most interested in checking are performance, cost-reducing features, ruggedness, delivery and service.

When it comes to service, the automobile makers expressed the thought that the situation does not differ much from that in U.S. machines—if a builder has good distributors the user gets good service; if a builder has poor distributors the user inevitably suffers from poor service. One of the Big Three went on record with the statement that it has had no trouble in obtaining parts and service where a good foreign machine tool has had good sales representation. Discussion of foreign machines with automobile people inevitably got back to one all-important fact, no matter how many other angles were explored—that these machines must have special qualities not to be found in American machines if they had a chance of being purchased.

Foreign machines in 15 major industry groups

ALL OF METALWORKING

Per cent of industry reporting:	9.5%
Plants reporting:	2732
Plants with foreign machines:	737
Total foreign machines reported:	2292

FARM MACHINERY
(SIC 352)

Per cent of industry reporting:	9%
Plants reporting:	72
Plants with foreign machines:	7
Total foreign machines reported:	11

CONSTRUCTION, MINING, MATERIALS HANDLING EQUIPMENT
(SIC 353)

Per cent of industry reporting:	13%
Plants reporting:	175
Plants with foreign machines:	30
Total foreign machines reported:	57

METALWORKING MACHINERY
(SIC 354)

Per cent of industry reporting:	25%
Plants reporting:	425
Plants with foreign machines:	178
Total foreign machines reported:	459

SPECIAL-INDUSTRY MACHINERY
(SIC 355)

Per cent of industry reporting:	17%
Plants reporting:	208
Plants with foreign machines:	64
Total foreign machines reported:	140

GENERAL INDUSTRIAL EQUIPMENT
(SIC 351, 356)

Per cent of industry reporting:	15%
Plants reporting:	190
Plants with foreign machines:	64
Total foreign machines reported:	221

FABRICATED METAL PRODUCTS
(SIC 34)

Per cent of industry reporting:	10%
Plants reporting:	700
Plants with foreign machines:	148
Total foreign machines reported:	326

OFFICE AND SERVICE MACHINES
(SIC 357, 358)

Per cent of industry reporting:	14%
Plants reporting:	76
Plants with foreign machines:	20
Total foreign machines reported:	72

ELECTRICAL EQUIPMENT
(SIC 361, 362, 364, 369)

Per cent of industry reporting:	8%
Plants reporting:	179
Plants with foreign machines:	49
Total foreign machines reported:	114

HOUSEHOLD APPLIANCES
(SIC 363)

Per cent of industry reporting:	11%
Plants reporting:	28
Plants with foreign machines:	6
Total foreign machines reported:	12

COMMUNICATIONS EQUIPMENT
(SIC 365, 366, 367)

Per cent of industry reporting:	6%
Plants reporting:	72
Plants with foreign machines:	17
Total foreign machines reported:	35

MOTOR VEHICLES AND PARTS
(SIC 371, 375, 379)

Per cent of industry reporting:	4%
Plants reporting:	84
Plants with foreign machines:	14
Total foreign machines reported:	29

AIRCRAFT AND PARTS
(SIC 372)

Per cent of industry reporting:	6%
Plants reporting:	62
Plants with foreign machines:	32
Total foreign machines reported:	132

PRECISION MECHANISMS
(SIC 38)

Per cent of industry reporting:	9%
Plants reporting:	116
Plants with foreign machines:	42
Total foreign machines reported:	392

ORDNANCE, SHIP-BUILDING. RAILROADS
(SIC 19, 373, 374)

Per cent of industry reporting:	17%
Plants reporting:	47
Plants with foreign machines:	14
Total foreign machines reported:	94

FORGE SHOPS, FOUNDRIES, MISCELLANEOUS
(SIC 332, 336, 339, 25, 359, 39)

Per cent of industry reporting:	5%
Plants reporting:	288
Plants with foreign machines:	54
Total foreign machines reported:	197

SOURCE: American Machinist

AMERICAN MACHINIST EDITORIAL RESEARCH REPORT

Foreign machine tools in US metalworking . . .

4. Have you been satisfied with foreign machine tools?

- *Have you in general been satisfied with the quality of your foreign machines? Yes: 628 No: 107*
- *Have you needed parts or services? Yes: 455 No: 250*
- *Has service been satisfactory? Yes: 400 No: 127*
- *Have parts been readily available? Yes: 325 No: 165*

Note: Actual totals, rather than percentages, are given. A plant with more than one foreign machine could answer both "Yes" and "No."

5. Do you plan to buy machine tools in 1959? and 6. How much will you spend on machine tools?

1133 plants, or about 42% of the plants that answered these two questions on spending plans, will invest in machine tools during 1959. These plants will spend a total of $64,856,000 this year for both foreign and domestic machine tools. The remaining 58% either don't plan to buy this year or were undecided when they replied. (For area expenditures, see the chart on the opposite page.)

These plants will buy 4925 machine tools, of which 195 will be foreign-built. In percentage terms, 4% will be imports. Dollar spending for foreign machines will also be 4%.

As the right-hand column in the table below shows, published figures are actual figures reported in the sample, and have not been expanded to include all of Metalworking.

SPENDING PLANS FOR 1959: A REPORT FROM 2683 COMPANIES

Industry	Buy machine tools in 1959? Yes	Buy machine tools in 1959? No	How many machine tools?	How many foreign machine tools?	Planned spending, machine tools	Planned spending, foreign machine tools	Per cent of industry reporting
Farm Machinery	31	41	112	1	$ 2,482,000	$ 7,500	9%
Construction, Mining, Materials Handling	76	98	325	18	5,166,000	222,500	13%
Metalworking Machinery	194	231	816	22	13,456,500	338,300	25%
Special-Industry Machinery	103	76	265	19	3,293,000	166,500	16%
General Industrial Equipment	84	106	425	20	8,540,000	349,100	15%
Fabricated Metal Products	254	440	1057	27	11,288,000	233,000	10%
Office & Service Machines	34	42	267	13	2,704,500	210,000	14%
Electrical Equipment	89	88	356	12	3,255,000	84,000	8%
Household Appliances	7	21	48	0	1,099,000	0	11%
Communications Equipment	36	36	157	7	1,032,000	40,000	6%
Motor Vehicles & Parts	35	49	202	8	2,363,500	43,000	4%
Aircraft & Parts	27	35	191	3	1,957,000	45,000	11%
Precision Mechanisms	50	66	264	10	1,887,500	69,000	9%
Ordnance, Shipbuilding, Railroads	18	29	141	10	3,396,000	440,000	17%
Forge Shops, Foundries, Miscellaneous	95	192	299	25	2,936,000	219,500	5%
Totals	1133	1550	4925	195	$64,856,000	$2,467,400	9.5%

SOURCE: American Machinist

Area distribution of imported machine tools

	Plants responding to survey	% of Metalworking in area responding	Plants with foreign machines	Total foreign machine tools reported	Buy machines in 1959? Yes	Buy machines in 1959? No	How many machine tools?	How many foreign machines?	Planned spending, machine tools	Planned spending, foreign machines
New England	291	13%	129	359	140	149	753	38	$ 9,010,500	$ 272,800
Middle Atlantic	616	10%	177	907	252	360	1174	53	14,790,500	674,000
Southern	241	11%	39	154	91	146	325	7	3,545,000	24,000
Great Lakes	539	8%	148	305	191	334	763	25	12,485,000	464,500
Midwest	573	9%	133	288	256	306	1105	31	15,801,000	551,100
West	222	11%	32	77	98	122	375	20	4,142,500	260,500
Far West	240	7%	79	202	105	133	430	21	5,081,500	220,500
Totals	2722	9.5%	737	2292	1133	1550	4925	195	$64,856,000	$2,467,400

NOTES: **New England:** Maine, New Hampshire, Vermont, Massachusetts, Rhode Island, Connecticut

Middle Atlantic: New York, New Jersey, Pennsylvania, West Virginia, Delaware

Southern: Maryland, Virginia, North Carolina, South Carolina, Georgia, Florida, Alabama, Mississippi, Louisiana, Texas, Eastern Tennessee

Great Lakes: Ohio, Eastern half of Michigan, Eastern half of Kentucky

Midwest: Northern Illinois, Indiana, Western Michigan, Iowa, Wisconsin

West: Minnesota, Southern Illinois, Western Kentucky, Western Tennessee, Arkansas, Missouri, Kansas, Oklahoma, New Mexico, North Dakota, South Dakota, Nebraska, Montana, Wyoming, Idaho, Utah, Colorado

Far West: California, Washington, Nevada, Oregon, Arizona

SOURCE: American Machinist

WHY FOREIGN MACHINE TOOLS WERE BOUGHT

	New England	Middle Atlantic	South	Great Lakes	Midwest	West	Far West
Characteristics and capacity equivalent to U S machines and price was lower	33%	26%	32%	29%	29%	21%	27%
Characteristics and capacity adequate though below U S machines but price was lower	13	11	14	9	16	4	27
Characteristics and capacity superior to U S machines	11	15	11	15	15	15	14
Unique performance characteristics not available in U S machines	21	26	29	24	26	32	13
Needed quick delivery and could get it in foreign machine	22	22	14	23	14	28	19

NOTE: Figures represent per cent of total response in each area

SOURCE: American Machinist

Plants that replied to the survey are well distributed throughout the United States. In terms of employees, returns ranged from 7% in the Far West to 13% in New England. (For definitions of each area, see the note below the large table on this page.)

The Middle Atlantic region (New York, New Jersey, Pennsylvania) reported far more foreign machine tools than any other area: 40% of the 2292 foreign machines reported are located in this area. The South, on the other hand, reported fewest—only 7% of the total.

The Middle Atlantic area will also spend more for foreign machine tools this year than any other area: $674,000, or 4.5% of planned spending for machine tools, will be invested in imported machines. But percentagewise, the West will lead all other areas in foreign-machine investment: 6.3% of the total spent for machine tools in the Trans-Mississippi—Rocky Mountain area will be for imported machines.

Here's the percent of total expenditures that each area will spend on foreign machines this year:

New England: 3%
Middle Atlantic: 4.5%
South: 0.7%
Great Lakes: 3.7%
Midwest: 3.5%
West: 6.3%
Far West: 4.3%

The smaller table, showing the area breakdown on why foreign machine tools were bought, discloses fairly consistent patterns. For the most part, plants bought foreign machines for the same reasons, regardless of the area in which the plants are located.

AMERICAN MACHINIST EDITORIAL RESEARCH REPORT

Foreign machine tools in US metalworking . . .

What size plants have foreign machine tools?

The smaller the plant, the greater the concentration of foreign machine tools. But a greater percentage of large plants have these machines. The graph on this page illustrates these apparently contradictory statements.

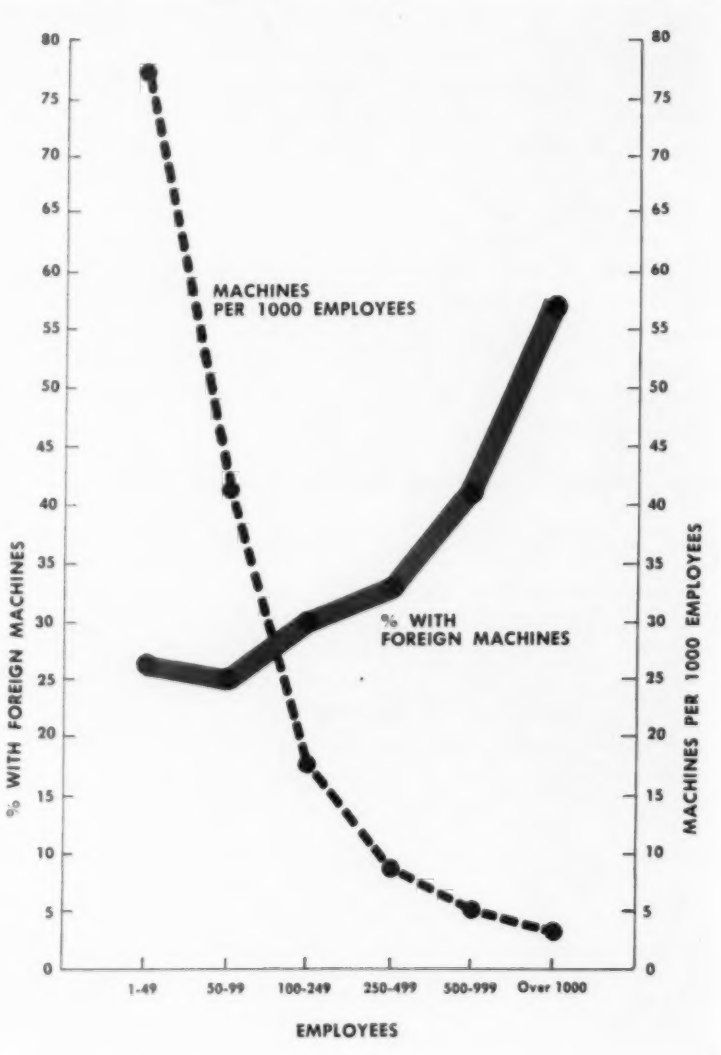
57% of plants with more than 1000 wage earners have foreign machine tools; on the other hand, only 26% of plants with fewer than 50 workers have them. But there are 77 foreign machines per 1000 employees in the smallest-size plants, only 3 per 1000 employees in the largest.

Here are the actual reported figures for these smallest and largest plant sizes: 216 out of 1048 plants with 1 to 49 employees answered "Yes" to the question "Do you now have foreign machines?" In plants with more than 1000 employees, 57 out of 100 replied "Yes."

Machines per plant go up as plant size increases. In the smallest plants, foreign machines average 2.3; the largest plants have an average of 8.5 foreign machines.

Returns from the 2722 plants in this survey represent a broad cross-section of large and small plants. The following figures show how many plants of all sizes—small, medium, and large—replied:

Plant Size, Employees	Number of Plants Reporting
1-49	1048
50-99	596
100-249	576
250-499	262
500-999	140
Over 1000	100



SOURCE: American Machinist

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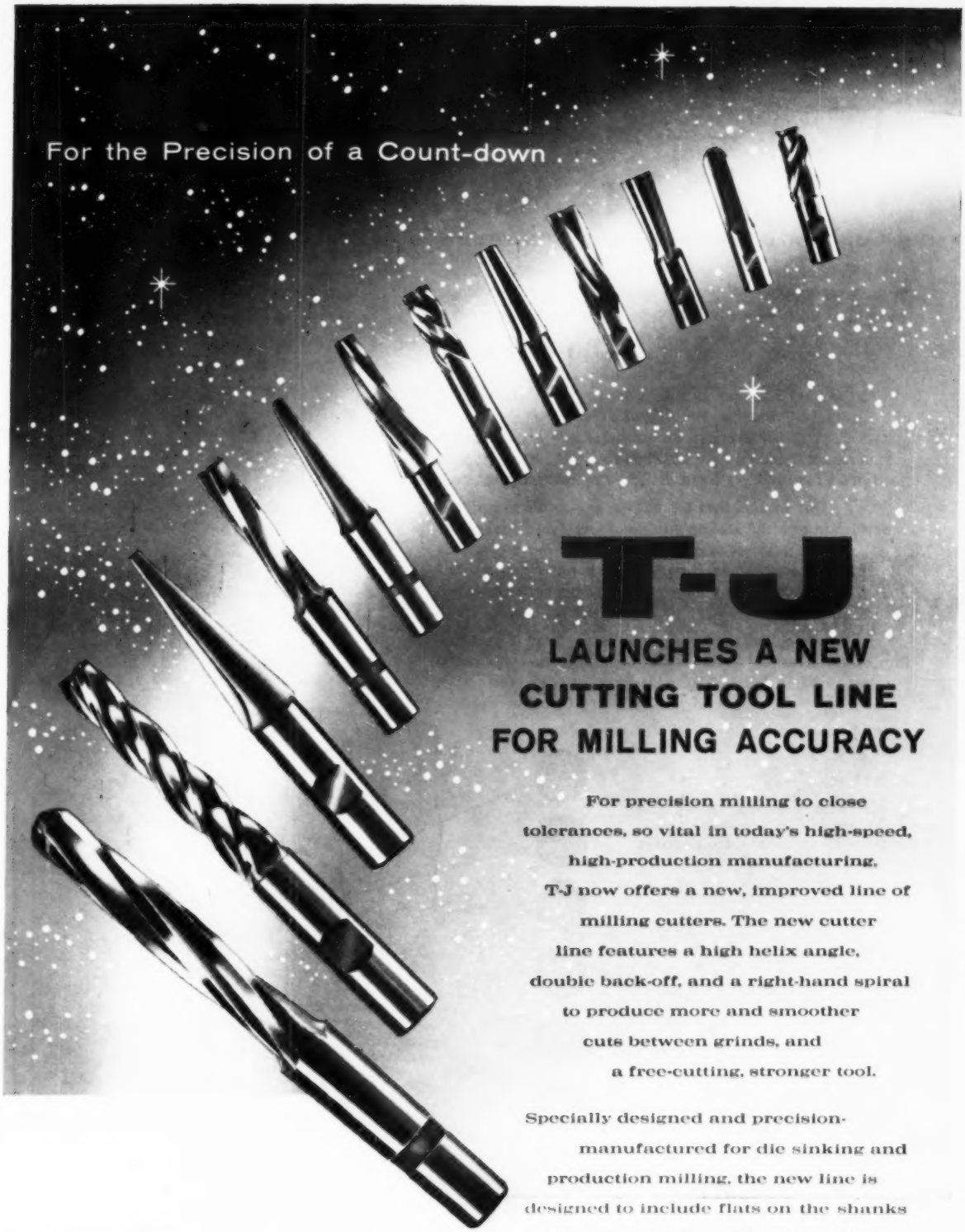

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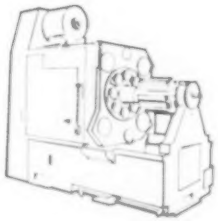

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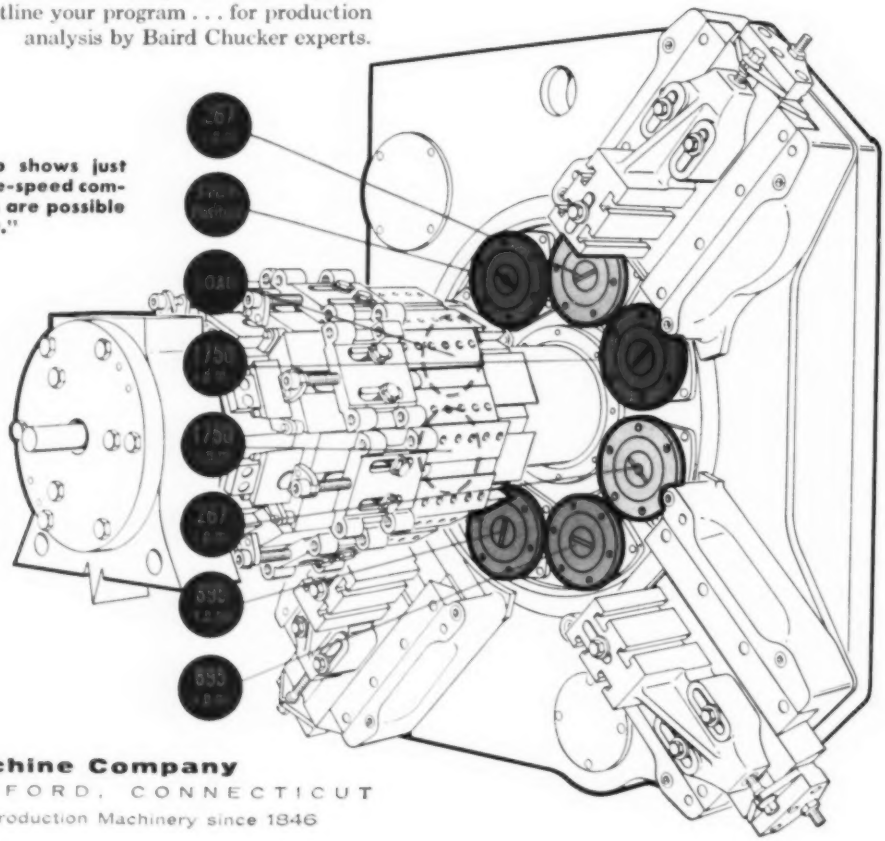

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Facts About Nickel Plating—I

Courtesy International Nickel Co, New York

Plating specialists at International Nickel Co receive each year many questions from practical engineers and shop men about nickel plating. Here are the facts in reply to most of these questions. A review of the answers is timely, because you are now free to employ nickel plating or nickel in any other form as much as you wish. There is an over-supply of the metal now, and according to the experts there should be enough in the future for all conceivable applications.

Practical Questions and Answers About Nickel Plating

What materials can be coated with nickel?

Any material that can be plated can be plated with nickel. Nickel plating combines the properties of nickel with the special properties of other metals—the formability of brass, the impact extrusion of aluminum, the strength of steel, or the design flexibility of die-castings. Nickel can be electroplated on plastics, too, if they are made conductive by special treatments.

Is an undercoating of some other metal required?

Nickel can be applied directly to most metals, but copper is sometimes used as an undercoating. This is usually for economic reasons, such as to provide a surface that is more easily buffed. In coating zinc and aluminum, it is usually necessary to apply a strike coating before applying the main nickel coating. The strike may be copper or it may be nickel applied from a special bath.

What are some advantages of plating other materials with nickel?

These are varied and numerous:

To provide beauty and distinction . . . to increase resistance to corrosion . . . to decrease contact resistance and friction . . . to improve solderability and brazing . . . to increase resistance to galling and wear . . . to salvage worn or mismachined parts. Nickel is a good conductor of electricity . . . conducts heat somewhat better than low-carbon steel . . . has a low coefficient of thermal expansion . . . is magnetic . . . can be electroplated almost as soft as the softest electroplated copper and almost as hard as chromium, and to almost any hardness in between.

Can nickel coatings be applied to rough surfaces to make them smoother?

Yes. Certain bright and semi-bright nickel baths have been specially developed to give them smoothing action. Platers usually refer to this as "leveling." When these baths are employed, the base metal does not have to be completely smooth. This means lower costs for polishing and buffing.

What about the appearance of nickel coatings?

There is a nickel finish for every need. Nickel coatings can be plated bright or they can be plated dull. And the dull ones can be very easily polished or buffed to any desired finish. Sometimes it is better to plate dull coatings and polish them to full brightness. For most applications it is more economical to plate the coating bright.

Why is chromium applied over nickel for decorative applications?

Bright nickel coatings tend to lose luster with time. To avoid this, very thin coatings of bright chromium are applied over the nickel.

Are other coatings applied over nickel?

In the manufacture of printed circuits, rhodium is frequently plated over nickel. In other applications an overlay of gold is used. In still others, tin may be electroplated over nickel to provide certain properties that cannot be achieved in any other practical way.

Can nickel-coated materials be formed?

Many nickel-coated metals—if ductile—can be formed, drawn, or stamped into a variety of shapes.

Soft dull coatings are usually more ductile than hard bright ones. Therefore, when objects are to be plated with bright nickel, they should be stamped or formed before plating.

How strong are nickel coatings?

Their strength depends on the composition and operating conditions of the plating bath. The ultimate tensile strength runs between 50,000 and 220,000 psi, with the coatings that are plated bright having the highest value.

Can nickel coatings be made more workable by heat treatment?

Heat-treating for about 15 min. at 1400 F will increase the ductility of dull nickel as much as 50%. Ductility reaches its peak under these conditions, but hardness and tensile strength are decreased.

Can electroplated nickel be welded?

With special precautions. However, tiny cracks will often develop in the region of the weld. And when they do, cracks are usually so small that they can be ignored for many applications. Consult experts if in doubt.

Can nickel coatings be machined?

Practically all nickel coatings can be machined, but sometimes it is better to grind the harder ones.

(Continued on page 149)

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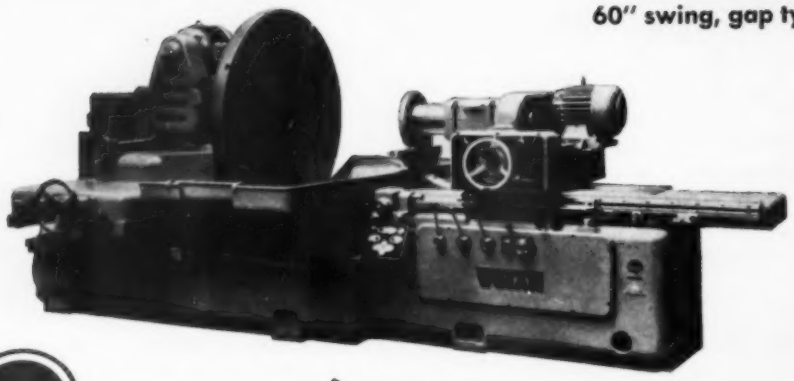
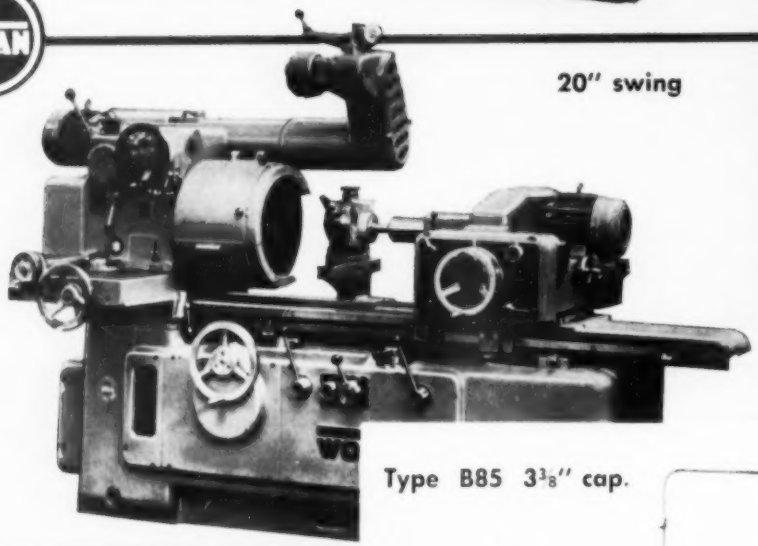


WOTAN

20" swing



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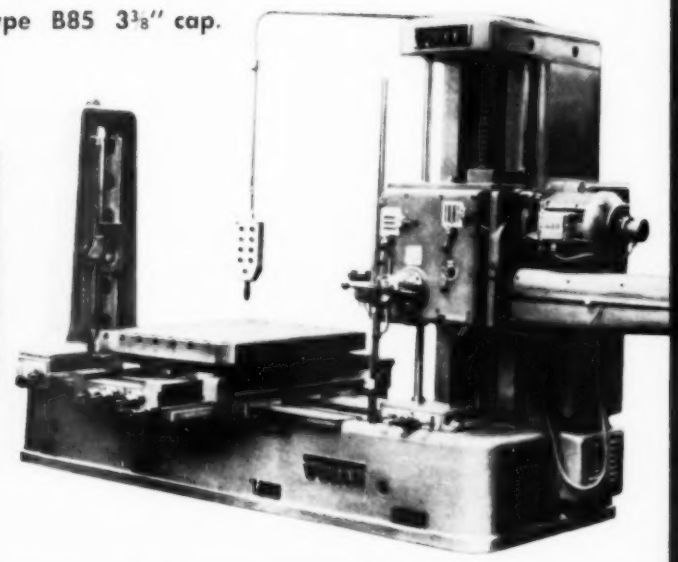

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Facts About Nickel Plating—II

Do nickel coatings provide good protection outdoors?
Nickel and chromium are a combination that weathers well in practically all atmospheres.

Can nickel coatings be exposed to chemicals?
Electroplated nickel is at home in alkaline mediums: soda ash, soaps, caustic soda and hot caustic liquors.

Nickel coatings also do an economical and satisfactory job in handling a variety of other chemicals, food and acids.

How much surface will a pound of nickel coat?
This will depend on the coating thickness. If a thickness of one mil is desired, one pound of nickel will cover about 22 sq ft.

What are some types of plating baths?
Most dull baths contain no special chemicals and involve no patent rights. There are at least 12 baths that yield dull deposits. By selecting the proper bath and operating conditions you can obtain nickel deposits for a wide variety of applications.

Bright baths are proprietary and contain one or more chemical compounds to make the coatings bright and impart other desirable characteristics.

Who distributes bright baths?
Here are some distributors:

Apothecaries Hall Co, Division of the Hubbard-Hall Chemical Co, Waterbury, Conn
Hanson-Van Winkle-Munning Co, Matawan, N J
Harshaw Chemical Co, Cleveland, Ohio
McGean Chemical Co, Cleveland, Ohio
Seymour Manufacturing Co, Seymour, Conn
Udylite Corp, Detroit, Mich

Can nickel be electroplated on the inside of pipes and tubing?
Yes. Steel pipe and tubing with nickel-plated internal walls are available from the Bart Manufacturing Co, Belleville, N J, under the tradename "Lectro-Clad."

Are nickel-plated sheets also available?
Nickel-plated sheets and plates are also manufactured by Bart.

What is electroforming?
Electroforming is a method of fabricating objects by electroplating nickel (or another metal) as a shell on a removable mold or pattern. No fabricating method gives the designer more latitude.

Questions on Techniques of Nickel Plating

Should bright chromium be applied to nickel before or after forming?
Bright chromium does not usually have good forming characteristics. Hence, it is better practice to apply bright chromium after the article has been formed.

About how thick should a coating be to give good performance?
This is a difficult question to answer, because the thickness required will depend on where and how the plated article will be used. For industrial applications fairly heavy coatings are used: 0.005 to 0.020 in. But for decorative applications much thinner coatings are used. The specifications tabulated are typical of those adopted by some automobile manufacturers for minimum baseplate thicknesses. Such specifications are also applicable to many other fields of decorative plating.

It should be noted, though, that the thicknesses in these specifications are minimums, and better performance can be obtained with heavier coatings.

In the table, letters D, F, K, and Q were arbitrarily adopted to designated grades of plating. Letter S refers to steel as the basis metal; C, to copper and copper alloys containing at least 50% copper; Z, to zinc and zinc alloys containing 80% zinc.

Exposure conditions and use of plated steel are too varied to permit any predictions of the average life of articles plated to the specifications of D.S., F.S., K.S., or Q.S.

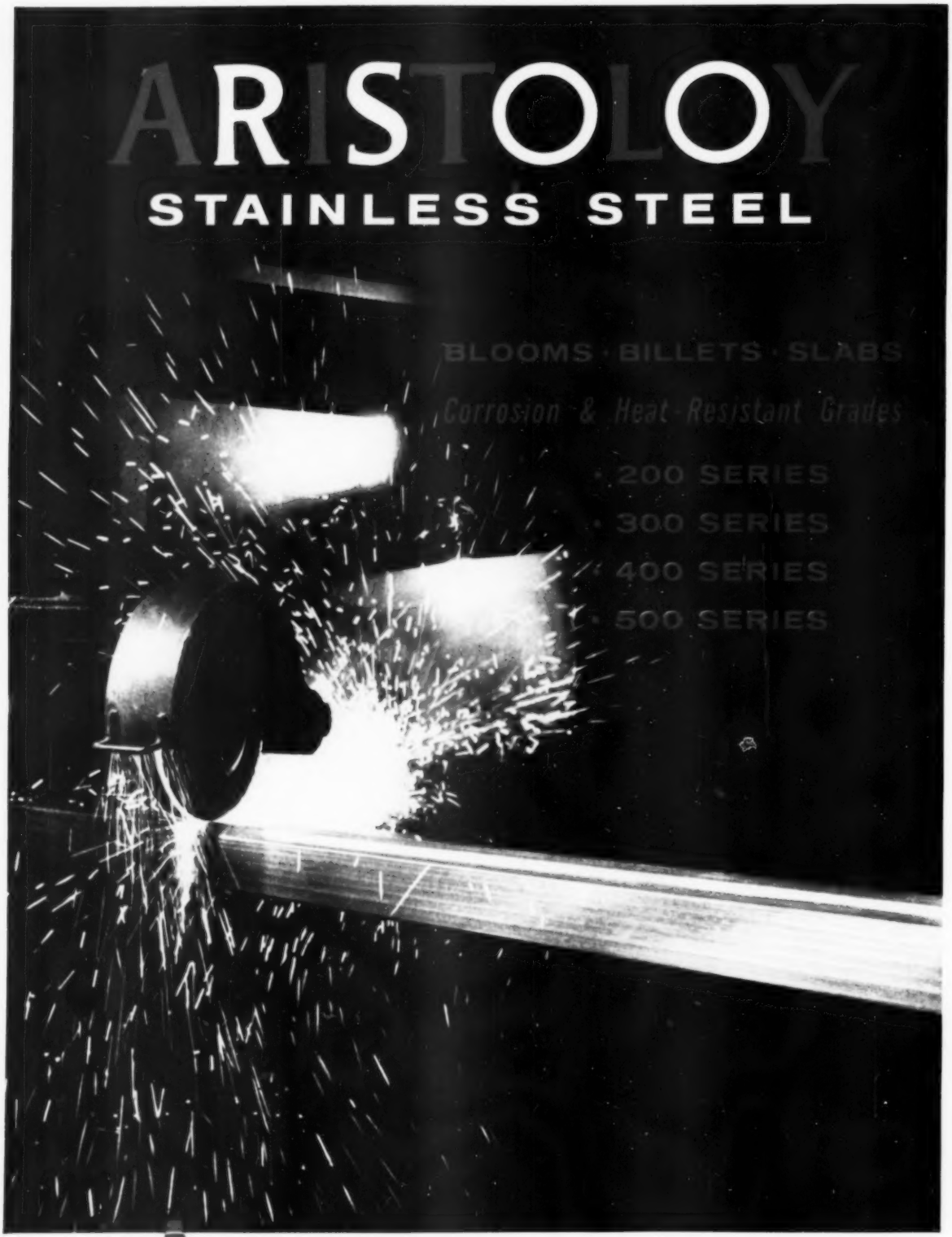
Is there any way to measure and control thickness?
One measuring device is well suited to measuring thickness up to about 0.003 in. on copper, brass, and steel. This is non-destructive and utilizes nickel's magnetic properties. There are other non-destructive tests, also used primarily in this thickness range. Destructive tests include measuring the coating with a microscope.

There are meters to measure the electric current going to a particular object. By an accurate check on this and the plating time, a plater can be sure that every object is coated with the same thickness.

Are special precautions required for heat treating nickel coatings?
Yes. In ordinary atmospheres nickel will begin to tarnish at around 750 F. This film will become darker and thicker at higher temperatures. If such films are undesirable, an inert or reducing atmosphere should be used. Whatever the atmosphere, it should be free from sulfur.

Unlike wrought nickel, the electroplated metal contains no sulfur-fixing elements. Hence, even a trace of sulfur in a furnace atmosphere will damage electroplated nickel by precipitating in the grain boundaries and causing serious embrittlement. For the same reason, sulfur in the as-plated coating should also be avoided if the coating is to be heat treated.

Is there a limit to the thickness of nickel that can be electroplated?
For some industrial equipment, coatings of 0.020 to 0.030 in. are common. For some electroformed objects, nickel deposits may be as thick as several inches. Of course, such thick deposits will require al-



ARISTOLOY STEELS

COPPERWELD STEEL COMPANY • Aristoloy Steel Division

4009 Mahoning Avenue • WARREN, OHIO

EXPORT: Copperweld Steel International Co., 225 Broadway, New York 7, N.Y.

Facts About Nickel Plating—III

ternate plating and machining to keep the deposits smooth.

How thin can electroplated nickel be?

Very thin coatings should only be used for special applications, because they will be porous.

Are there other ways besides electroplating for applying nickel coatings?

Commercial methods are: (1) electroless plating, sometimes called chemical reduction, (2) heat reduction, (3) vapor deposition, (4) simple immersion. Not all methods are suited to all applications. For complicated shapes, electroless plating is often the best way. For others, heat reduction may be the answer.

Just what is electroless plating? Is this the same as the Kanigen process?

Electroless plating is a process for plating nickel without the use of electric current. It is sometimes called plating by "chemical reduction" because a chemical is used to plate out the nickel metal.

The method was developed by Dr Abner Brenner and his associates at The National Bureau of Standards and is covered by patents assigned to the U.S. Department of Commerce. This means that they are royalty-free.

Brenner's method is best suited for plating small objects. However, it has been adapted and engineered for medium-scale production by the Metal Processing Co, who market equipment, solutions, and operating instructions under the name "Lustralloy."

Kanigen is also a type of electroless plating. The name stands for "catalytic nickel generation." This process was developed and patented by the General American Transportation Corp, 135 S LaSalle St, Chicago, Illinois, and represents modifications and improvements in the Brenner method. These include improvements in the quality of the coating, the rate of plating, and other changes that make it possible to plate a variety of shapes and sizes from a tube to a tank car.

What are some of the properties of electroless nickel?

Electroless nickel can be applied over many metals —and non-metals, too. It is also suited to applying uniform nickel coatings on a variety of complicated shapes—something that cannot always be easily done by electroplating.

Electroless nickel is extremely fine-grained and hard. Hardness is around 500 Vickers, or 48 Rockwell C, and can be doubled by a mild heat treatment for about one hour.

What about heat-reduction? Is this the same as "Niphos"?

The heat-reduction process is the same as Niphos, which is a patented method for plating nickel without electric current, developed by the New York Testing Laboratories. In this process, a water slurry of nickel oxide and other chemicals is painted on the object to be coated. This slurry is dried and heated at high temperature in a reducing-gas atmosphere. During firing, some diffusion takes place with the base metal, so that the resulting coating is an alloy containing some iron—as well as nickel and phosphorous. Phosphorus content ranges between 1 and 3%.

The coating has useful properties. It is ductile and hard, with a hardness around 400-500 Vickers. As it wets well and can be readily brazed, it can serve a two-fold function of providing protection and joining two, or more, coated parts.

Niphos can be applied to a number of metals, but its chief use is as a coating for steel. Examples: pipe and fittings—especially for cargo heating coils in ocean-going tankers.

What is meant by vapor plating?

The metal to be deposited is evaporated at elevated temperature in a vacuum. Coatings applied are usually quite thin, and best suited to special applications. For example, the thermal decomposition of nickel carbonyl, as employed by the Commonwealth Engineering Co, is said to be ideal for electroforming particular objects. Vacuum deposition is often used to coat plastics and is well suited to the jewelry trade.

What is immersion plating?

Immersion plating is a simple procedure for applying very thin coatings to steel. The part to be plated is immersed in a special water solution of nickel salts, and nickel metal deposits on the surface of the steel. No electric current is required. Coatings applied in this way are primarily used as base coatings for enamels.

Minimum Thicknesses of Electrodeposited Coatings

Nickel and Chromium on Steel

	Type D.S.	Type F.S.	Type K.S.	Type Q.S.
Copper plus nickel, min.	0.0020*	0.0012	0.00075	0.0004
Final nickel, min.	0.0010	0.0006	0.0004	0.0002
Chromium (if required) min.	0.00001	0.00001	0.00001	0.00001

* When copper is used in excess of a thickness of 0.0001 in., its minimum thickness shall be 0.00075 in.

Nickel and Chromium on Copper

	Type F.C.	Type K.C.	Type Q.C
Nickel, min.	0.0005	0.0003	0.0001
Chromium (if required) min.	0.00001*	0.00001	0.00001

* Chromium coatings 0.00005 in. or more in thickness are likely to cause cracking of nickel deposits on brass. An effort should therefore be made to obtain the required minimum thickness of chromium with as low a maximum as practicable.

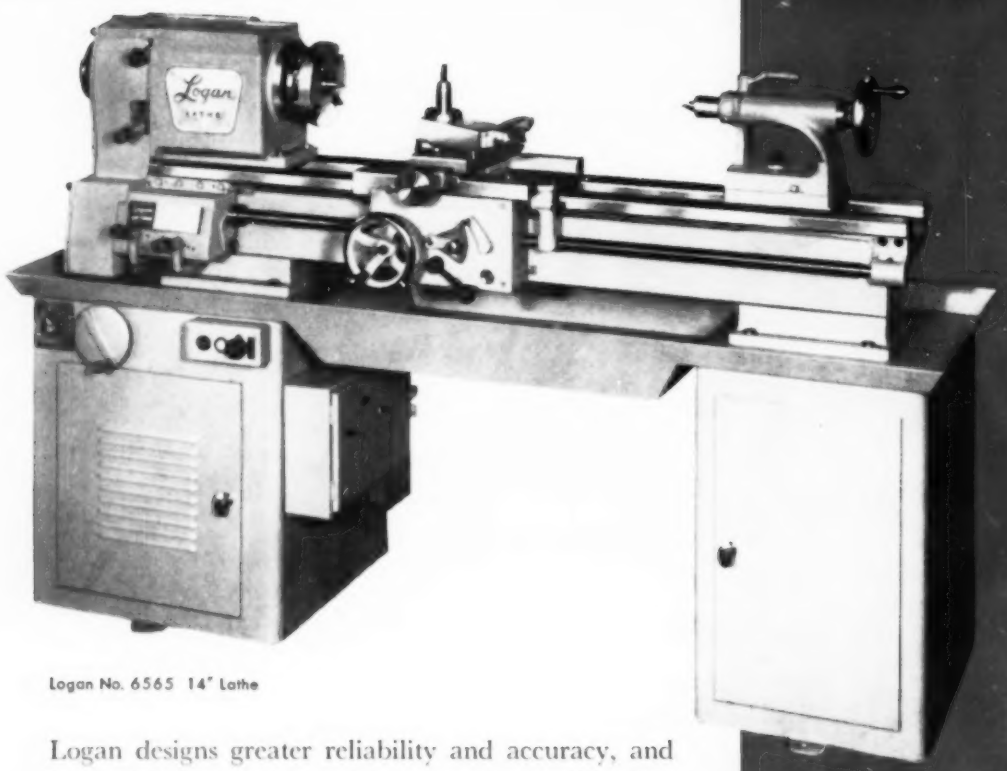
Nickel and Chromium on Zinc and Zinc Alloys

	Type F.Z.	Type K.Z.	Type Q.Z.
Copper plus nickel, min.	0.0012	0.00075	0.0005*
Copper, min.	0.0002	0.0002	0.0002
Final nickel, min.	0.0005	0.0003	0.0003
Chromium (if required) min.	0.00001	0.00001	0.00001

* Total of 0.0003 in. if alternative of nickel is used.

its specifications add up to high production capacity

Logan 14" Lathe



Logan No. 6565 14" Lathe

Logan designs greater reliability and accuracy, and longer life into its lathes by a generous combination of high-quality features. For instance—

- An oversize spindle with 1⅝" bore turns on four super-precision ball bearings with built-in preload
- A variable-speed drive lets you change speed while work is turning—without shifting belts
- A warp-free lathe bed with high, strong walls braced by oversize ribs to withstand heaviest stresses; two V-ways and two flat ways are flame-hardened and precision-ground.

There are many more reasons why this and other Logan Lathes have a greater capacity. The specifications tell the story. Write for literature and complete information.

- **Spindle speeds to 2000 rpm.**
- **1½" Levermatic collet chuck capacity**
- **14⅝" swing over bed**
- **9" swing over saddle cross slide**
- **40" between centers**

LOGAN ENGINEERING CO. Dept. G-459 4901 Lawrence Ave., Chicago 30, Ill.

Talking Shop...

Hydraulic vs Mechanical

AT ALASKA COPPER CO in Seattle, a test was made on output of mechanical and hydraulic brakes. Strips of 14-gage steel, each 10 ft long, were given two 90° bends. The operation was repeated for four hours on each brake, using the same operator. Because of the shorter stroke height on the hydraulic brake (adjusted to the minimum permissible) there were 30% more strokes per minute with the hydraulic brake.

Warmup

FACED WITH the problem of running one of those big panel discussions at a recent SAE Production Forum, Glenn Periman of North American Aviation, prepared a remarkable get-acquainted booklet for the panel members. It included both formal and informal information on the panel members, including statistics on offspring. There were clues to the approach each member might be expected to take in the informal give-and-take of the discussions. The whole thing was made lively by some clever drawings winding up with a blunderbuss-enforced admonition to "Be There." This folder looked rather elaborate, but was really a simple "dittoed" production.

That New Inch

THOSE VARIED comments on the International Inch presented in a recent symposium in our pages (*AM*—Feb 23 '59, p89) stimulated J C Morgan to some comments in a newsletter: "Engineers with slide rules and mathematicians with imagination will remind us what this 'new inch' can do to the American people. The shortage multiplies when you compute in cubic measure. For instance, take 231 cubic inches to a gallon—just figure the loss in every fifth!"

Corridor Talk

"IN THE OPERATION of every shop there are three systems: First, the one that has been put down on paper; second, the variation on the first that the management thinks is followed; third, the way things really get done."

"Put out an order that everything has to be made exactly like the drawings and we wouldn't ship a single thing for six months."

Paint Job

SOME PEOPLE COMPLAIN every year because they paint a green stripe down Fifth Avenue in New York for the St Patrick's Day parade. They say it costs too much. But how would you like to paint the entire surface of a 60-ft highway leading from Miami, in Florida, to Fairbanks, Alaska? That is how much paint General Motors uses every year.

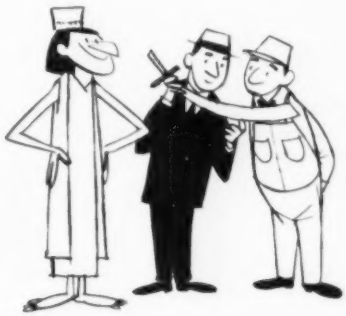
Putting it into figures, it amounts to 7½ million gal of lacquer, 3½ million gal of primer, and 9 million gal of thinner. All this flows through 225 miles of circulating pipe lines that require 48,000 gal just to fill them up. Add to this the 51,000 gal to fill the pressure tanks and you have nearly 100,000 gal in the system before you spray a single car body.

Free Center Drill

CUMMINS ENGINE CO gets a center drilling operation free by doing it through the spindle while aluminum pistons are being bored, faced, turned, and chamfered. A cam driven, spring-loaded drilling spindle is connected directly to the main camshaft of the Seneca Falls lathe. The spindle is in a retracted position when the piston casting is mounted in the chuck. When the main camshaft is engaged to begin the machining operations, it drives an auxiliary shaft through a chain drive. A cam roller transfers this to linear motion of the center drill (which is keyed to prevent rotation). Because center drilling and skirt boring are done simultaneously in the same chucking, alignment is assured.

MEMOS

by BESS RITTER



The "modern" smelting methods that we use today are so old that ancient peoples employed the same type of furnaces which are utilized now—including both the open hearth form and the blast type. As a matter of fact, according to the conclusions reached at a recent meeting of the Iron and Steel Institute in Great Britain, a specimen of ancient iron was declared to be superior to any type that can be put out today.

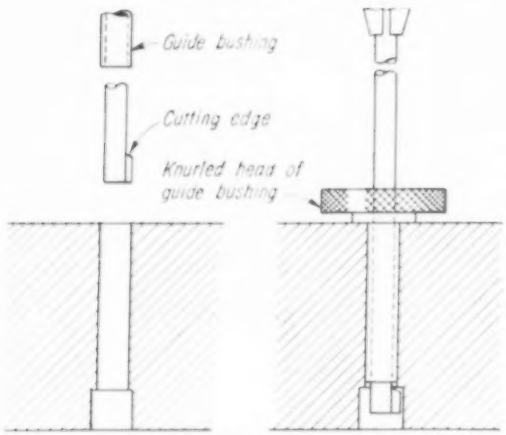
This specimen is the famous "Kutob column" which was found in the vicinity of Delhi, India. It is approximately sixty feet long, weighs about seventeen tons, and is composed of solid iron. Although it is estimated to be about thirty centuries old, it doesn't bear the slightest bit of rust, and close examination hasn't divulged any kind of scar which would indicate that the column had been either welded or seamed.

Although James Watt is credited as being the inventor of the steam engine, this type of machinery was well known in Alexandria 1500 years before Watt was born. The inventor was a man named Hero. His basic process required a tightly-lidded boiling kettle, a hollow sphere, and a tube. The tube transferred the steam from the kettle to the sphere, which was put into rapid motion. This, in turn, motivated other instruments.

One reason why such steam power fell into disuse was because any kind of power wasn't really essential. Slaves were commonplace in those days, and there was enough around to take care of all the heavy work required. The steam process was considered a novelty, and it was utilized for nonessential gadgets.

Practical Ideas...

Back Face Deburring Job Made Easy With Portable Tool



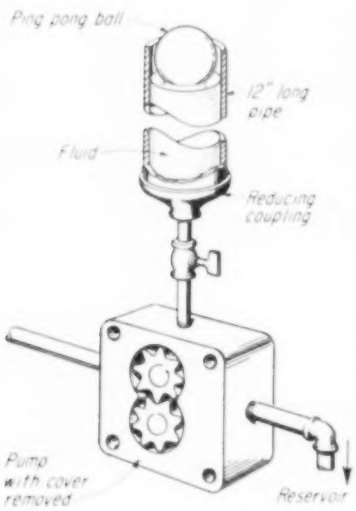
This tool is particularly convenient when holes requiring deburring are located in a heavy workpiece. Its versatility and portability makes this possible. Powered with an air drill or slow electric drill, it will do a job in minutes that would otherwise take hours.

The cutting tool with its long shank is made from tool steel to somewhat resemble the shape of a boring bar. Its cutter lip is formed in the same manner as that on a boring bar, except that the cutting edge is at the back of the lip. The width over lip and bar is slightly less than the diameter of the drilled hole. The overall length of the shank must be the length of the hole plus the length of a guide bushing with an additional ⅛ in. for clearance. This dimension does not include section gripped in the chuck.

The guide bushing is bored to a sliding fit on the tool shank and should be slightly short of the length of the hole. A good fit is also necessary between the OD of the bushing and the drilled hole. The knurled head of the bushing provides a convenient grip for manipulating the bushing.

To use the tool, the cutter is inserted through the hole as far as it will go. The bushing is then entered full depth, whereupon the power is turned on as the cutting edge is brought into contact with the burr. A few revolutions clears the burr out, and the power is shut off after which the bushing is pulled out followed by the cutter.

C S Roberts, Chessington, Surrey, England



Primer Assures Pump Operation

When gear pumps become worn, they sometimes are unable to raise liquid after having lost their prime during idleness. If then, repair or complete replacement are not expedient, a simple primer can be attached to the pump extending its useful life indefinitely.

Access to the pump chamber is drilled with a ¼-in. pipe-tap drill from the top surface of the pump. After the hole is tapped a ¼-in. pipe nipple is installed and fitted with a petcock. A reservoir, made up of a 12-in. long piece of 1½-in. pipe or tubing, is mounted on the petcock by way of a reducing coupling and a ¼-in. nipple. Assembly completed, the reservoir is filled with liquid and a ping pong ball dropped in to float on top and act as a level indicator.

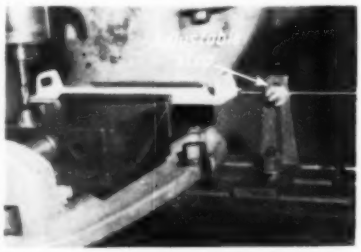
Now, if the pump fails to lift after power has been turned on, the petcock is opened to prime the chamber. As soon as the pump takes hold, it will be noticed that the primer will begin to refill. When the ping pong ball can be sighted near the top, the pet cock is shut off and the primer is ready when again needed.

John L. Elliott, Birmingham, Mich

Adjustable Stop Simplifies Repeat-Milling Operations

This tool was designed to speed setting up work in the milling machine. It provides a reference point from the surface being machined so all parts will be of exact length or width. A stop rod is positioned against a machined surface of the work while the part is gripped in the milling vise.

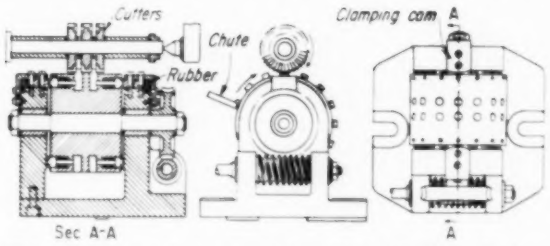
The body of the stop consists of a steel angle with two 5-in. long x 2½-in. wide legs. Each leg has a ½ in. x 4 in. long slot milled through its center. The slot in the base leg makes it possible to position the stop at any point on the table, while the vertical slot provides the necessary up-and-down adjustment of the rod. A neater appearance is given the vertical leg by tapering the edges as shown.



The stop rod is fashioned from drill rod with a chisel point at one end and a conical point at the other. Its length can be anywhere from a few inches to a foot long, depending on requirements. A ½-in. stud is flattened and drilled to support the rod horizontally with a washer on each side of the vertical leg for smoother adjustments and better clamping.

George Robitchek & Jack Johansen, RCA experimental shop, Los Angeles, Calif

Rotary Milling Fixture Grips and Feeds Work Automatically



This hopper-fed fixture requires little attention during operation except that of keeping the hopper supplied and finished parts cleared away. From a hopper, the fixture accepts, clamps, and feeds the workpieces past the cutters, after which it discharges them, all automatically.

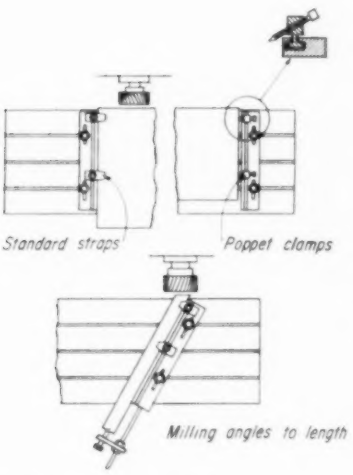
The drum of the fixture is provided with 2 rows of 16 blind holes in each. The depth of these holes is closely controlled so that the parts inserted will project an equal amount as they pass the cutters. Workholding pressure is supplied by spring-return plungers which are brought into contact with the work through cams. The small ends of the plungers are machined to the radius of the work for better contact, and the rounded heads are keyed to keep plungers in line.

The cams, which are mounted on top of the frame on either side of the drum, activate the plungers as the workpieces approach the cutters. Once the parts have passed the cutters, pressure by the cams is released, leaving the parts free to drop out as they near the bottom of the drum. In back of both cams are rubber or neoprene bumpers to take up overload pressure.

A worm gear arrangement drives the drum. This may be independently powered, or power takeoff made from one of the machine feeds. The frame is cast (but can also be constructed as a weldment) with the back side removable to facilitate assembly. The shaft is keyed to the drum and rotates in bronze bushings. Adjustments to centralize the drum are made by the shaft's end nuts. A spacer washer between the drum and the stationary side of the frame serves as gage.

Straddle mills are arranged with spacers on the horizontal arbor so that identical cuts are taken on each side of the workpieces. Parts are loaded into a vibratory hopper which transfers and inserts them into the drum through a chute.

Hjalmar Dahl, Upplands Vasby, Sweden



T-slot Bars Simplify Many Milling Operations

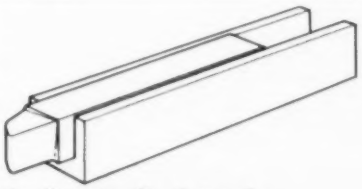
Edge and face milling, as well as cutoff and angular milling operations, are made easier with the T-slot bars shown. In cases where work has to be performed on the entire surface of a piece, as in vertical milling, poppet clamps can be used at any convenient location in the slot of the bar.

This application is shown employed in the right-hand side of the upper sketch. Another bar, simply squared with and bolted to the table, serves as stationary stop at the opposite end of the workpiece. At the left in the same sketch, standard straps are used to apply clamping pressure where needed. In this case, the workpiece is light and, being edge milled, is held down close to the cutter.

The lower sketch illustrates how a T-slot bar is used to line up a piece in a production setup. A long threaded rod, screwed into the end of the bar, carries an adjustable stop to maintain identical lengths.

These bars can be made from either steel or cast iron, and are machined with the accuracy of parallels so that, when necessary, they can be used as such. A T-slot of the same dimensions as those in the table is machined along one edge of each bar. The reason for all slots being alike is that this allows standard T-nuts and poppet clamps to be used. Two elongated holes are milled through the bars to provide for adjustments when securing them to the table. Width of machine table, or size of work to be handled, usually determines the length of the bars. When the ends have been squared off, holes are drilled and tapped at each end for stop rods.

A A Sinisi, Mt Vernon, NY



Toolbit Cradle Extends Usefulness of Special Tools

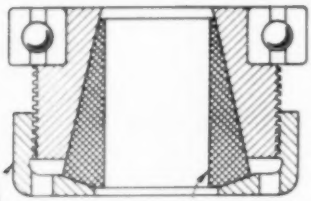
When a toolbit has been ground for a special job, it is usually limited to the size machine for which it was first intended. Should it later become necessary to use the same type of tool in a machine having larger toolholders or boring bars, duplication usually has to be made on the larger toolbit.

This duplication can be eliminated with a cradle insert. When used together with the smaller toolbit, any size toolholder may be employed. All that is necessary is that the outside dimensions fit the toolholder, and that the inside will snugly accept the toolbit.

The illustrated cradle is made from a piece of $\frac{3}{4}$-in. square stock. Its groove is $\frac{1}{4}$-in. wide and $\frac{1}{4}$-in. deep to allow a $\frac{1}{4}$-in. toolbit to be used in a $\frac{3}{8}$-in. holder. Cradles for other sizes and combinations are made the same way.

Walter Gerstel, Berkeley, Calif

Collet Adapter Improves Steadyrest



One end in each of a large number of tubes had been necked down by swaging. The next operation required that these ends be bored concentric with the OD and in line with the axis of the tube.

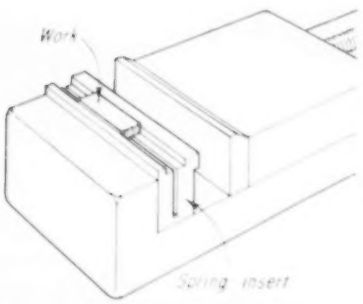
These specifications made it necessary to employ a steadyrest, but the roughness of the swaged section presented another problem. The neck could not be used to support the tube, and to set the steadyrest behind this portion would mean excessive overhang resulting in chatter marks.

A solution was neatly found in a shop-made collet adapter designed to be gripped in the steadyrest. It utilizes Jacobs rubber collets like those used in Jacobs spindlenose chucks. Irregularities created by swaging are absorbed by the flexibility of the rubber collet. The adapter is gripped by the steadyrest on the outer race of a ball bearing press fitted onto the back end of the adapter.

The body is bored with a 13° taper to match the OD of the rubber collet. A 3-in. 10 square thread is machined on the periphery for the collet cap. The diameter of the ball-bearing seat is ground after hardening to hold concentricity between this surface and the bore within 0.0002 in.

When the cap has been bored and threaded to suit the body threads, the generous relief is finished off in a 20° taper to provide a proper landing on the face of the rubber collet. The periphery of the cap is then finished with a medium knurl, and four equally divided holes are drilled in the face to accept a spanner wrench which is used when more torque is necessary to tighten the collet.

John Dudonis, tooling-shop foreman, Grumman Aircraft Engineering Corp, Bethpage, L I, N Y



Vise-Jaw Insert Holds Work

When thin parts have to be milled in quantity, work holding is a problem. It then appears that the vise is awkward, parallels won't stay put, and chips give you trouble.

By replacing the insert in the stationary jaw of our milling vise with a gripping insert, we have simplified this operation. The special insert serves two purposes. It not only grips the workpiece, but it also eliminates parallels. Chips are easily cleaned off the landing surface in preparation for the next piece.

We made the insert out of a piece of CR steel to about the same height and length as the original insert. Its thickness was made ½-in. wider than the width of the workpiece, giving us a ¼-in. lip along each edge after a recess had been milled.

A saw cut into the center of the insert toward the bottom provided the necessary flexibility. The inside face was undercut producing a narrow pressure area at the top, and the counterbores for the mounting screws were made deep enough to pass through the saw cut.

Arnold Koch, Milton, Ontario, Canada

John S Reeves
Tottenham, England

$25 In addition to regular payment for his idea:

SIMPLE TOOL LIFTER PROTECTS CARBIDE TOOL

in the Feb 9, 1959 issue

An extra $25 will be paid for the best Practical Idea in each issue of *American Machinist*. Selection of the winner is made by a group of our readers.

PAYMENT—$25 in addition to regular rates for the items published to be paid as soon as reader votes are received—usually three to four weeks after the date of issue. The winner will also be announced in these pages as soon thereafter as practicable.

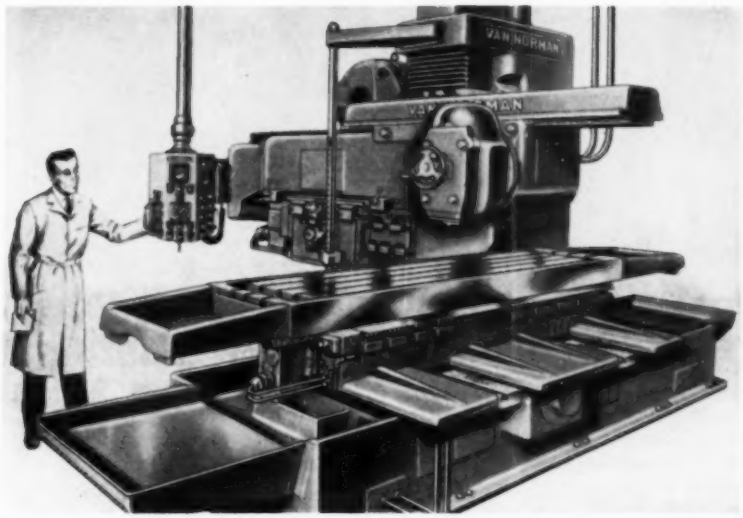
JUDGES—A group of 200 *American Machinist* readers is asked to select preferred articles in each issue. The group is a true cross-section of all readers, and changes entirely each time. Their votes, in addition to guiding the editors, select the best Practical Idea. If at any time their votes result in a tie, $25 will be paid to each co-winner. Decision of the readers will be final in each case.

REQUIREMENTS—Only items in the Practical Ideas pages are eligible, and they must be submitted directly by the originator. Do not worry about your shortcomings as a draftsman, photographer, or author—every item will be edited in accordance with *American Machinist* standards and suitable illustrative or explanatory material added where needed. Readers will judge only the finished product—in terms of its usefulness to them.

WHO MAY ENTER — Anyone may enter except employees of the McGraw-Hill Publishing Co, Inc, and those of advertising agencies or departments. Suggest to your employees that they submit ideas.

HOW TO ENTER — Send all entries to "Practical Ideas Editor," American Machinist, 330 West 42nd St, New York 36, N.Y.

New Shop Equipment
Materials and Parts



Milling Machine Cuts or Shapes New, Tough Superalloys to Close Tolerances

Adaptable to either punched or magnetic numerical control systems, No. 746 Versi-matic milling machine is designed to cut or shape newer, tougher superalloys to close tolerances on big jobs.

A special four-way cutterhead, with a total swivel of 120°, makes it possible to cut in a variety of positions without changing the workpiece. Horizontal, angular, and vertical milling can be performed with a minimum of changeover, tooling, and material handling time. Cutterhead speed range is 15 to 1500 rpm in 18 steps. There is a 25-50 hp drive to the spindle.

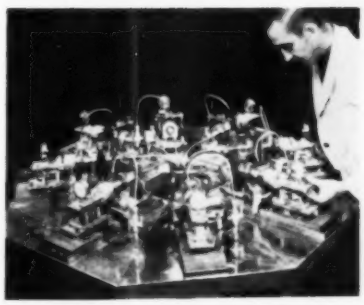
Table size is 96 by 24 in. Maximum clearance from spindle to table (horizontal) is 35 in. and from spindle to table (vertical) is 22 in. Weight is approximately 37,000 lbs.

Travel distances: vertical 35 in., ram 44 in., table 50 in., saddle 14 in.

For precise positioning, the No. 746 is equipped with illuminated optical vernier scopes and scales. A portable pushbutton control at each optical scope station pinpoints readout.

Van Norman Machine Co, Springfield 7, Mass

MORE DATA? Circle 51, inside back cover



Multi-Station Ultrasonic Machine Cuts Hard, Brittle Materials

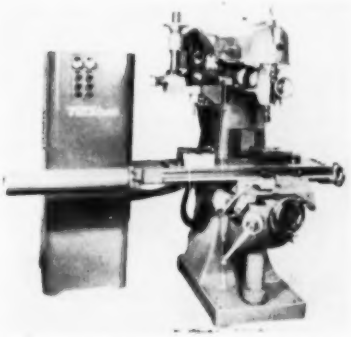
Reported to be capable of doing the work of eight conventional ultrasonic units, this 8-station Sheffield-Cavitron ultrasonic machine tool was designed to meet the increasing need for production machining of germanium, silicon, ferrite, glass, quartz and other hard, brittle materials. Known as the Sheffield-Cavitron 8, the machine has its eight horizontal machining stations arranged in a circle on a waist-high table 54 in. in diameter.

In addition to saving space, the machine is lower in cost—about one-half the cost of eight single machines. Lower operating costs result from the use of a single electronic generator and a single transducer.

The machining stations, capable of simultaneous or independent action, can take cutting tools up to 1.08 in. in diameter, machining workpieces to a depth of 0.050 in. One operator can easily handle this machine.

The Sheffield Corp, Dayton 1, Ohio

MORE DATA? Circle 52, inside back cover



Automatic Die-Sinker Converts Into 360° Contouring Machine

A tracer control valve, which operates at the flip of a switch, makes it possible to convert this automatic die sinker into a 360° contouring machine.

As a die sinker, the machine combines such automatic features as feed rate control, reciprocation, depth control, and indexing or "pick-feed." The machine requires an operator only for setup.

As a contouring machine, the Ricipro-Matic will perform precision machining on vertical interior or exterior walls and on complex shapes.

Turchan Follower Machine Co, PO Box 657, Inkster, Mich

MORE DATA? Circle 53, inside back cover

Bendix Introduces 4-Axis Tape Control Unit for Machine Tools

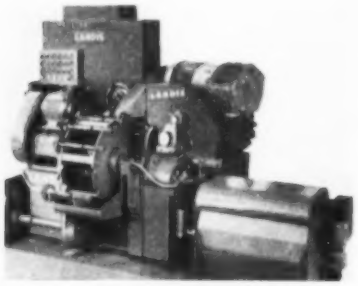
The 4-axis machine control unit will simultaneously control the horizontal, vertical, longitudinal and tilt positions of machine tools with a command resolution of 0.0002 in.

linear and 0.01 degree rotary in the machining of any part that requires a twist-type cutting operation. Typical parts would be engine mounts, bulkheads, airfoil sections, etc.

Input is punched tape. The high-speed reader reads 300 lines per second in the forward direction and 600 lines per second in reverse. An automatic tape re-wind eliminates need for operator selection of re-wind at end of operation, and allows operator to remove the part as the tape is being rewound. For assistance in setup and in manual operation of the machine tool during simple machining operations, four decimal display position indicators are provided, displaying continuous readout of position located on all four axes.

Bendix Aviation Corp, Industrial Controls Section, 21821 Wyoming Ave, Detroit 37, Mich

MORE DATA? Circle 54, inside back cover



Precision Production Grinder Has Hydraulic-Mechanical Feed System

Type R plunge grinder, designed for cylindrical work, is said to grind to closer tenth tolerances than previously possible with a high production automatic grinder.

Introduced on this grinder is a combination hydraulic and mechanical feed system, called Microfeed, which can duplicate its action for piece after piece. It will feed the grinding wheel in increments as small as 50 millionths of an inch and always resets the same amount from finish size on each cycle, regardless of the amount of fine feed previously required to reach the final size of the workpiece.

The grinder also features newly designed wheel dresser, headstock, footstock, and lubrication system. It is available with straight or angular wheel head. A formed grinding wheel or several grinding wheels can be used, making it possible to grind a face and several diameters in one operation.

Landis Tool Co, Waynesboro, Penna

MORE DATA? Circle 55, inside back cover

Specially Counterbalanced 25-Ton Press Operates at 1000 Strokes Per Minute

This 25-ton press, equipped with a special counterbalancing system to minimize vibration, has a production line capacity of 1000 strokes per minute. In operation at the plant of a retaining ring manufacturer, the press uses a triple-cavity die to stamp the rings at the rate of 3000 per minute.

The press, called Model 1625, has a ½-in. stroke, with solid connections, and a bolster adjustment of 1 in. Bed opening is 5 by 16 in. and bolster plate area is 12 by 20 in.

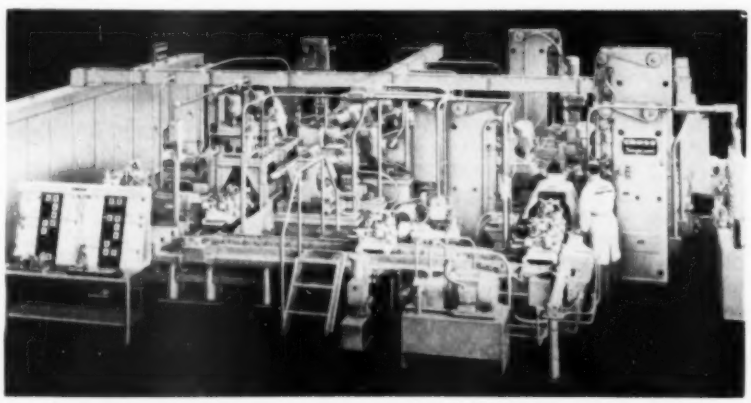
It also has an electric clutch which permits rapid torque pick-up and quick stops.

Because of the high operating speed, it was necessary to develop a precision light-duty single roll feed, set to pull the strip through the press. In the retaining ring application, strip 0.050 in. thick by 3 in. wide is fed into the press at 500 ipm.

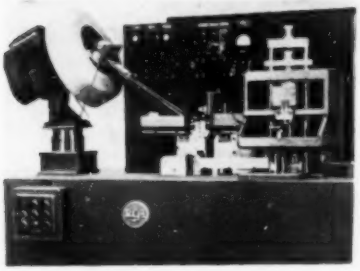
The recirculating oil system which provides lubrication to main bearings, connection bearings, and gibs is monitored by interlocks which stop the press instantly if the pressure varies either up or down from the line pressure of five pounds.

E W Bliss Co, 1375 Raff Rd, SW, Canton 10, Ohio

MORE DATA? Circle 56, inside back cover



TYPEWRITER POWER FRAMES are processed on this Cross transfer line at the rate of 150 per hour, at 100% efficiency. Each frame requires 105 broaching, milling, drilling, reaming, spotfacing, chamfering and tapping operations. Processing the delicate frame on a high-speed line required overcoming critical problems of holding close tolerances and providing precise clamping pressure—*Cross Co, Park Grove Station, Detroit 5, Mich* MORE DATA? Circle 57, inside back cover



Hardness Tester Checks Up to 2500 Parts Per Hour

Using an electronic gaging system, this machine automatically checks parts for hardness at rates up to 2500 per hour.

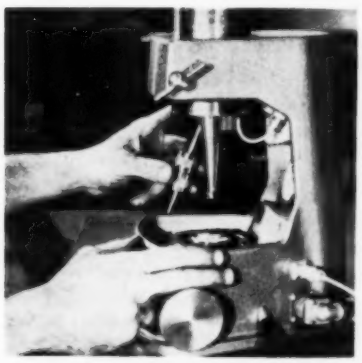
The operator places the parts on the conveyor carrying them to the checking station where they are transferred one at a time to the hardness checking penetrator. The depth of penetration causes voltage changes in a gage head which are taken off and converted to a smoothly varying direct current directly proportional to the degree of hardness.

This dc voltage also actuates the segregating gates which classify the tested parts into categories after they have been discharged from the checking station.

The machines are available with such additional features as automatic orienting and feeding of parts, multi-dimension checking, selective segregation and counting.

Radio Corporation of America, Industrial and Automation Div, 12605 Arnold Ave, Detroit 39, Mich

MORE DATA? Circle 58, inside back cover



Ultrasonic Impact Drill Features Automatic Tuning, Greater Speed

Reported to be the only piezoelectric drill available to industry, the Glennite 100-watt impact drill will drill faster and work on larger areas than previous models and will retune automatically as impedance changes, according to the manufacturer.

In addition to drilling, the unit will also slice, engrave, shape, tap, broach, dice, shave, trepan and machine. It can be used on such materials as ceramics, glass, silicon, germanium, tungsten, granite, ferrite, tungsten carbide, quartz, precious stones, and aluminum oxide.

Cost is $1,100.

Gulton Industries, Inc, 212 Durham Ave, Metuchen, NJ

MORE DATA? Circle 59, inside back cover

Automatic Machine Laps Or Rollburnishes Shafts

Model SFA is an automatic machine for lapping or rollburnishing bearing surfaces on straight shafts or camshafts.

Equipped with automatic loading and unloading devices, the machine handles shafts up to 36 in. long and with a maximum outside diameter of 12 in. It can accommodate shafts with bearing surfaces ½ in. wide or more and with at least 1¾ in. between centers. Maximum outside diameter with standard lapping heads is 3 in.

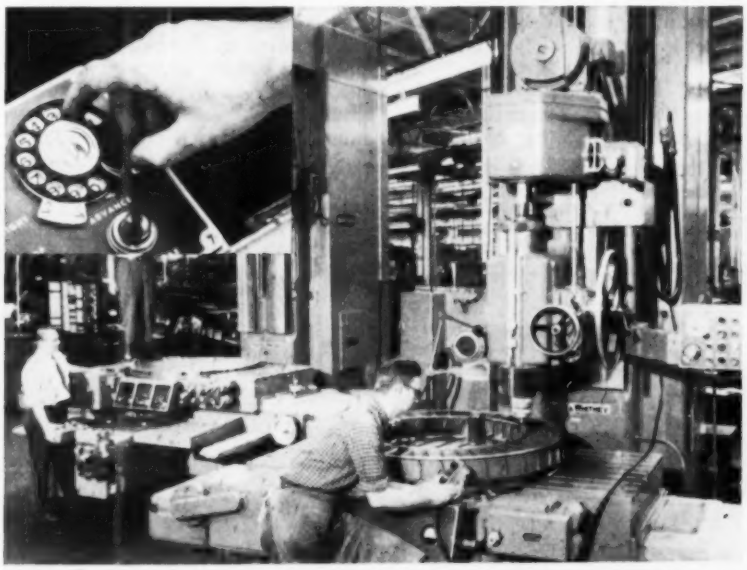
The machine can turn out a 5 to 7 mu-in. rms finish on parts which have been finish ground or precision turned to at least a 40 mu-in. rms finish.

In production, the Model SFA can finish all bearing diameters on straight shafts at a rate of 250 pieces per hour at 80% efficiency. On cam shafts, typical production for lapping cam lobes and bearings is up to 80 pieces per hour at 80% efficiency. Roll burnishing of bearing diameters on straight shafts or cam shafts is up to 150 pieces per hour at 80% efficiency.

The Model SFA can be equipped with a maximum of five bearing heads and 16 cam lapping heads. A 5-hp motor, equipped with clutch and brake, provides spindle drive. Floor space required is 66 by 84 in., height is 62 in. and net weight approximately 6500 lbs.

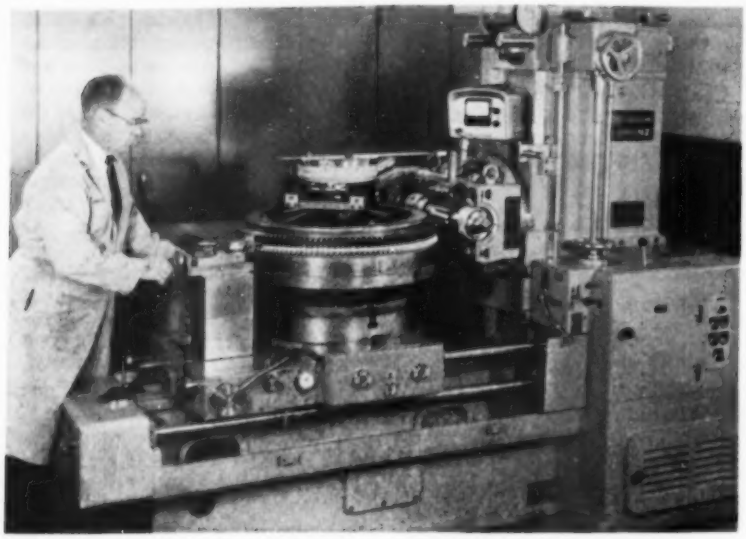
Foote-Burt Co, Cleveland 8, Ohio

MORE DATA? Circle 60, inside back cover



WORLD'S LARGEST JIG BORERS are positioned by a telephone dial system. Operator reads the machine settings, dials them like a telephone number, and the machine's electronic system takes over. In use at Pratt and Whitney Aircraft, the machines can handle workpieces as high as 70 in., parts up to 125 in. dia, and can bore to the center of an 80-in. dia workpiece—*Pratt and Whitney Tool Co, West Hartford, Conn*

MORE DATA? Circle 61, inside back cover



Michigan Tool Offers Modified German Gear Shaper and Hobbing Machines

US versions of Lorenz (West Germany) gear shapers and hobbing machines will be marketed here by Michigan Tool Co. Named Michigan-Lorenz, the machines will consist of one line of shapers in seven models and two lines of hobbers in a total of seven models. All machines conform to JIC standards and carry US electrical equipment and controls.

Both series of hobbers are of the heavy-duty type, one series for medium size gears, the other for large sizes. All the hobbers are of the vertical single spindle variety, designed for both conventional and climb hobbing, with power infeed.

Of the medium capacity hobbers, Model E-9 (illustrated above) has a maximum gear capacity of 35½ in. dia and is recommended for pitches up to 3. The E-12 Model has a maximum pitch of 2 and can handle gears having diameters as large as 4 ft.

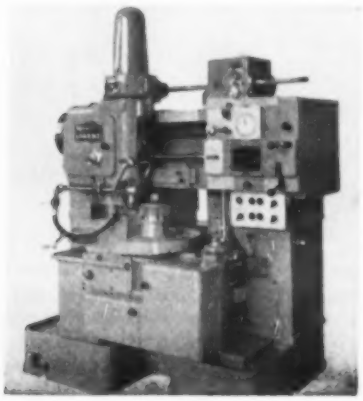
In the large capacity line, there are four models ranging in gear capacity from 63 to 157 in., with 15 to 30 hp and 49 to 85 in. work table dia.

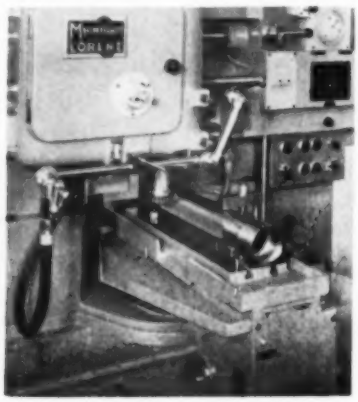
The standard gear shaper line has four models for gears up to 20 in. dia. In addition there are two models designed for shaper cutting of close gap herringbone gears and a seventh machine designed for cutting racks up to 6 ft long.

Illustrated at lower left is Model SN-5 for cutting gears up to 20 in. dia, 17½ in. on internal gears. Maximum face width is 3 in. and maximum recommended pitch is 5. This model and others are available with the rack cutting attachment illustrated lower right.

Michigan Tool Co, 7171 E McNichols Rd, Detroit 12, Mich

MORE DATA? Circle 62, inside back cover





Crown and Taper Attachment Fits Continuous Indexing Gear Grinders

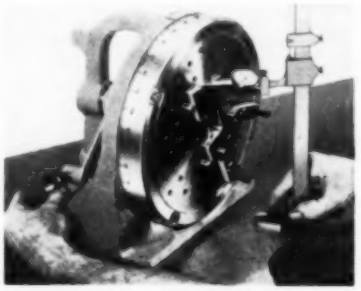
Designed for installation on foreign-made gear grinders of the continuous indexing, gear-generating type, this crown and taper attachment modifies the tooth form while the normal grinding process is taking place. Because there is no interference with normal operation, a crowned gear can be ground as rapidly as a conventional gear.

Crowning is accomplished by varying the chordal thickness of each tooth of the gear in such a way that it is greater in the center than at either end. In the case of tapering, the chordal tooth thickness is greater at one end than at the other. In either case the basic involute profile remains the same for the entire width of the gear face.

The attachment can be easily disengaged, permitting conventional grinding. Cost of the attachment, complete with all parts and installation, is $3400.

Crownco Enterprises, 1209 9th St, North Bergen, NJ

MORE DATA? Circle 63, inside back cover



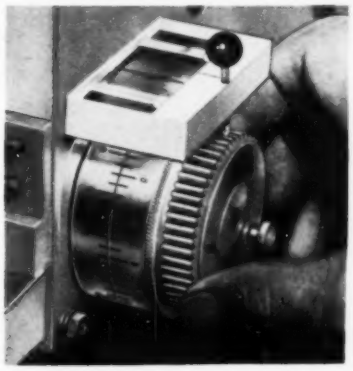
Rotary Inspection Fixture Has Sine-Bar and Angle Vernier

A rotary layout and inspection fixture, named Roto-Mike, is reported to combine sine-bar accuracy and vernier speed in checking angular relationships.

Using a measuring ring with a 360° vernier scale, workpieces mounted on the faceplate may be rotated quickly and precisely through any desired series of concentric angle settings. The ring also has four sine-bars equally spaced on a 10-in. circle. The independent faceplate may be rotated and adjusted separately from the measuring ring, and the two then locked together in any setting.

Sorensen Center-Mikes, Inc, 264 Kossuth St, Bridgeport, Conn

MORE DATA? Circle 64, inside back cover



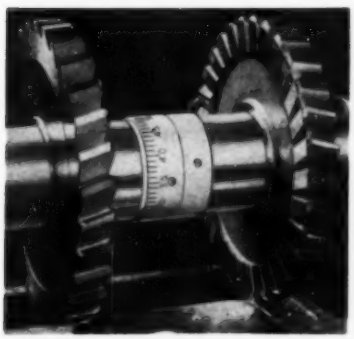
Gear Set Vernier Guarantees Accuracy Tolerance of 0.001 in.

Gear set vernier guarantees settings of calibrations to an accuracy tolerance within 0.001 in. automotically, according to manufacturer. Each vernier dial incorporates a gear whose teeth coincide with the dial calibration. In setting for a desired calibration, operator depresses the gear set pinion which automatically positions the carriage precisely to an accuracy tolerance of 0.001 in., regardless of inaccuracies attributable to the human element in reading and lining up a vernier to the hairline marker.

Instrument is available on the Gelb line-up and register tables, Add-A-Matic counters, and Monoruler vernier dials.

Jos Gelb Co, 52 Arlington St, Newark 2, NJ

MORE DATA? Circle 65, inside back cover



Adjustable Arbor Spacers Speed Straddle Milling Setup

Adjustable micrometer spacers each have one thousandth gradations. They eliminate use of shim-stock and/or paper as a means of spacing. They are available in ⅜ to 1½-in. widths; larger sizes up to 5 in. can be made on special order.

Narrow sizes have 1/16-in. adjustment, wider sizes up to ¼ in. One revolution equals 1/16 in. Each spacer has a keyway slot. Those with widths ⅜ to 1 in. are non-locking design; widths 1½ in. and up are locking type.

Mayer Engineering & Mfg Co, 815 S 9 St, Milwaukee 4, Wis

MORE DATA? Circle 66, inside back cover

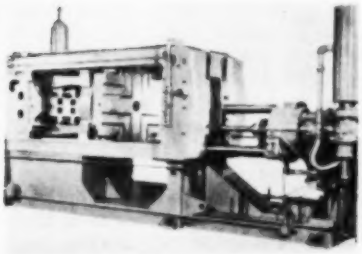
16-in. Cut-off Saw Powered By 7½-hp Totally-Enclosed Motor

Model M-750, 16-in. cut-off saw, is powered by a 7½-hp totally-enclosed, fan-cooled motor and cuts ferrous and non-ferrous metals at the rate of two to four seconds per square inch to tolerances of less than 0.010.

Saw features: geared-in-head motor and self-centering vise that is adjustable for accurate angle cutting up to 46 degrees. It is available for manual, semi-automatic and fully automatic operations.

Stone Machinery Co, Inc, Manlius, NY

MORE DATA? Circle 67, inside back cover



Aluminum Die Casting Machine Available in 1000 Ton Capacity

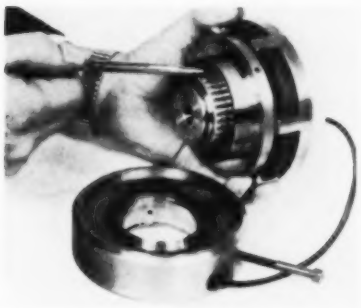
Designed to make 40-lb castings of such parts as gas meter housings, street lighting housings, and outboard motor blocks, this aluminum die caster has a capacity of 1000 tons and an unobstructed movable platen, 60-in. wide, with a vertical clearance of 60 in. between the beams.

The 1000 tons of pre-load clamping is made possible by the one-piece alloy steel frame. High initial speed and high final impact is provided by the pre-fill injection system. Stroke of the injection plunger is 25 in. and the injection shot end of the machine is adjustable from 2 to 12 in. below center.

Maximum die height is 42 in., adjustable to a minimum die height of 39 in., with a total daylight of 72 in. The die opening is adjustable from 30 to 10¼ in. There is a 35 by 103-in. opening at the top of the frame.

Lester-Phoenix, Inc, 2711 Church Ave, Dept N-41, Cleveland 13, Ohio

MORE DATA? Circle 68, inside back cover



Magnetic Clutch Said To Be Virtually Maintenance-Free

A stationary-field magnetic clutch, said to be virtually maintenance-free, is also reported to provide more torque for its size than any other unit commercially available.

The clutch has no air gap adjustments to be made, and no slip rings and brushes to be cleaned, adjusted or replaced. A closed flux path through hardened steel laminations eliminates the need for adjusting air gaps. Use of a stationary magnetic field—coil windings are on the stator instead of the rotor—eliminates slip rings and brushes.

They are designed specifically for such jobs as speed changing, feed drives, brakes and couplings in drive systems of lathes, boring mills, planers, milling machines and grinders.

Designated EC-S, the clutch series includes five sizes with torque ratings ranging from 14 through 290 lb-ft.

I-T-E Circuit Breaker Co, 1900 Hamilton St, Philadelphia 30, Penna

MORE DATA? Circle 69, inside back cover

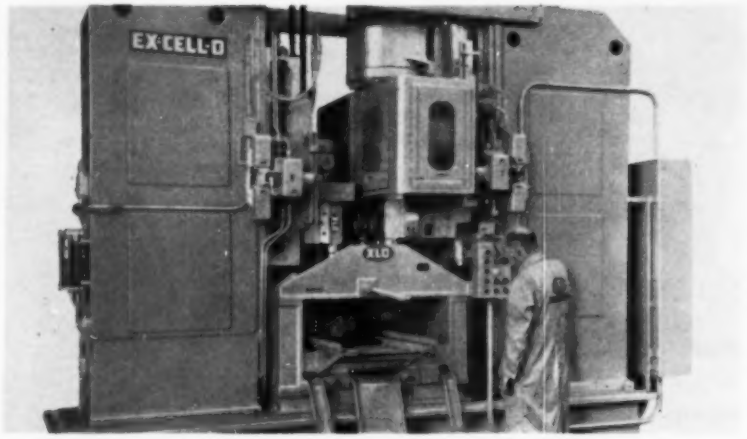
400-Ton Capacity Turning Rolls Position Vessels for Welding

Designed for smooth rotation of heavy-wall vessels for welding or cladding, these turning rolls will accurately support loads over 400 tons. Wheels measure 30 in. OD with 7 in. faces.

The rolls have four selective speed ranges from 4 to 80 ipm for positioning vessels from 3 to 14 ft, or larger. Slave motors on each unit are synchronized by a remote power source and provide positive tractive pull at the wheels for 500 tons. They can be used for either automatic or manual welding.

Aronson Machine Co, Arcade, NY

MORE DATA? Circle 70, inside back cover



DIESEL FLYWHEEL HOUSINGS, made of cast-iron and aluminum, are machined on two Ex-Cell-O precision vertical boring machines at the rate of 18 per hour. Each machine is capable of rough and finish boring and chamfering as many as nine holes in one pass, ranging in size from ⅜ to 5⅜ in. dia. Bore sizes are held to ± 0.0005 in. and locations to ± 0.0015 in.—*Ex-Cell-O Corp, 1200 Oakman Blvd, Detroit 32, Mich.* MORE DATA? Circle 72, inside back cover

French Lathe Performs Standard And Tracer Work Simultaneously

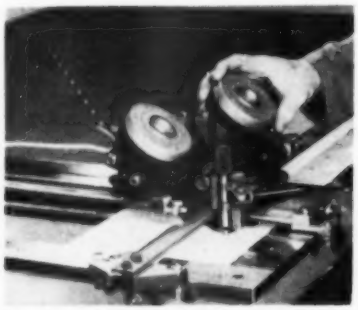
HB models of Cazeneuve lathes (French) can perform contour turning and standard lathe operations at one set up, and frequently at the same time.

The machine also features spindle speeds up to 3200 rpm; unitized spindle construction providing spindle accuracies to 0.000050 in.; tool positioning to 3 microns; copying equipment that performs both facing and longitudinal contour operations; full pressure lubrication to all slides.

Models are available from 18 to 36 in. turning diameter, capacity, with bed lengths available from 27 to 30 in.

Cazeneuve Sales Co, 755 Pennsylvania Ave, San Francisco 7, Calif

MORE DATA? Circle 71, inside back cover



Inspection Table Checks Location Of Holes in Flat Sheet Metal Work

Using this inspection table, an operator checking the location of holes in jigs, fixtures, templates and other sheet metal work, can read the X and Y coordinates directly—in 0.0005-in. increments at the rate of one to three holes a minute.

He can inspect material up to 36 by 42 in. without using angle plates, verniers, height gages, or similar indicators, and no compensating figures or calculations are necessary.

The table works like this: The workpiece is fastened against the locating edges of the table top with quick-acting clamps. The operator moves the carriage with the optical scanners and X and Y scales to the hole to be inspected, inserts the stylus into the hole, and reads the centerline dimensions from the edges of the sheet. Scales are graduated to 0.050 in.

Wiedemann Machine Co, Dept 814, Gulph Rd, King of Prussia, Penna

MORE DATA? Circle 73, inside back cover

Swiss Thread Chaser Grinder Has 4-in. Multi-ribbed Wheels

The Reishauer BS Thread Chaser grinding machine (Swiss) is specially designed to grind all types of flat threads and grooved profiles, such as those on chaser dies, flat rolling dies, and racks.

It operates with multi-ribbed grinding wheels up to 4 in. wide, and performs grinding wheel profiling by means of hydraulically controlled profile crushing.

For setting required pitch angle in grinding radial chaser dies, the worktable can be swiveled ±6°. To grind the taper in radial dies, the table can also be tilted ±6°. A special indexing device makes it possible to grind workpiece surfaces of a regular polygon shape to a maximum length of 14 in.

Maximum pitch is 4 tpi, minimum is 32 tpi. Maximum stroke of the table is 16 in.

Imported by Cosa Corp, 405 Lexington Ave, NY 17, NY

MORE DATA? Circle 74, inside back cover

How the Lindner Jig Borer's Optical Measuring System reduces tooling costs

at F. J. Stokes

Production Jig Boring and Inspection at Stokes—51 holes, .750" diameter, 9" to 15" deep, in head of rotary tablet machine held to +.0005", —.0000" on Lindner Model LB15A. Holes are perpendicular to the base and parallel to each other within .0005".

Lindner Model LB15A has 44" x 24" table with exclusive AUTOPOSITIONER® for pre-selecting initial and repeat table settings.

"Greater accuracy in jig boring proved to be the key to more economical tooling," says Bill Kale, Chief Production Engineer at F. J. Stokes Corp., Philadelphia. "When we installed a Lindner, costs were substantially reduced."

How does the Lindner achieve this greater accuracy? Through a unique optical measuring system. Here's how it works:

There are no lead screws. No gage blocks. No bars or limit switches. The helically scribed, cylindrical measuring scales are touched by a light beam *only*. These scales are independent of the table movement mechanism and immovable in axial direction. Thus, the whole system is permanently protected against any mechanical wear whatever. Lifetime accuracy. And lifetime *economy!*

Says Mr. Kale: "Before installation of the Lindner, it was impossible to achieve such consistent accuracy. Manufacture of tooling and laying out complex jobs has now been greatly simplified. And the Lindner optical measuring system makes it possible for us to inspect the work *right in the machine.*"

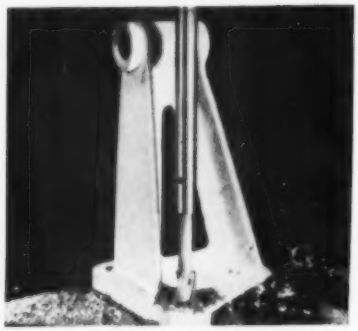
The Lindner optical measuring system is changing ideas about jig boring all over the country. We've packed all the facts into an informative 25-minute movie film. Send for it today without obligation, or write for literature.

KO CO., INC. PRECISION MACHINERY

KURT ORBAN

COMPANY, INC.

36 Exchange Place, Jersey City 2, New Jersey



Counterbores and Countersinks Available with Extension Sets

A new line of HSS solid counterbores and countersinks is available with extensions which can be used singly or joined in a series of two or more to reach the required depth. The cutting tools can also be used without the extensions.

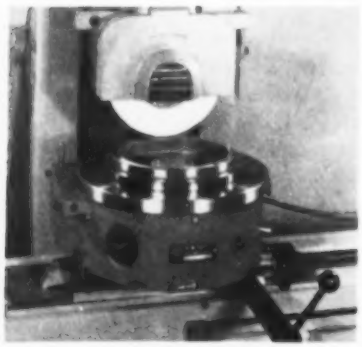
All extensions have lapped holes and are ground for minimum runout. Solid pilots in the counterbore can be changed without disturbing the extension. Tool shanks are ground to a tolerance of 0.0003 in.

The manufacturer also has a new line of aircraft counterbores with ¼-in. shanks for portable tools. Used with an extension, a short counterbore with a ¼-in. shank can be used for heavy-duty work in a stationary machine.

Counterbores can be furnished from ¼ through 1 in. by 64ths and countersinks from ⅜ through 1 in. by 16ths with seven standard included angles.

Bicknell-Thomas Co, Greenfield, Mass

MORE DATA? Circle 75, inside back cover



New Roto-Grind Model Offered With Variable Speed Control

Model 710-V motorized rotary table incorporates variable speed control (20 to 60 rpm), a forward and reverse switch, clutch for hand-operating, new casting with enclosed motor, and is designed to fit the majority of surface grinders. Unit converts any surface grinder to a rotary grinder for rough or precision work. It can be set up vertically for internal or external grinding, is easily installed, needs no air—only plugging into a 110-v ac outlet.

Variable speed transformer is provided to give correct rpm in relation to surface feed required in grinding. Accuracy up to 30 millionths tolerances can reportedly be obtained on grinding a 10-in.-dia plate flat. Model fits on a jig grinder for grinding large rings, offset holes, radii, or contours. It is furnished in 6-in., 10⅝-in., and 15-in. diameters.

M & M Tool & Mfg Co, 1124 E Third St, Dayton 2, Ohio

MORE DATA? Circle 76, inside back cover

Vacuum Lifter Lifts and Moves Steel and Nonferrous Plates

Latest addition to the company's line of vacuum lifting devices, this Square Cup Vacuum Lifter has two 20-in. square vacuum cups, each with 400 sq in. of lifting surface. At 10 psi, this is a total lifting power of 4000 lb per cup; with a 4-to-1 safety factor the capacity is still 1000 lb.

The twin-cylinder, high volume, dry-piston vacuum pump requires no oil and is capable of maintaining 27 in. of vacuum.

This lifter can handle even the most rugged jobs. Since the vacuum pump maintains a constant reserve of vacuum in the tank, even an electrical failure will not immediately release the load. The square cup design can be adapted to the Vac-U-Mation units having from one to eight cups.

F J Littell Machine Co, Vac-U-Mation Div, Dept 3-C, 4127 Ravenswood Ave, Chicago 13, Ill

MORE DATA? Circle 77, inside back cover

High-Speed Balancer Handles Parts From 1 oz to 27 lbs

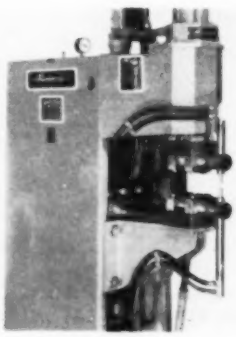
The Rava (Italian-made) Type S Gyro Balancer can balance as many as 80 or more gyros, armatures and other rotors per hour at speeds up to 14,000 rpm. Three models are available, for parts weighing up from 1 oz to 27 lbs.

The part to be balanced is mounted on adjustable nylon supports and driven by a peripheral belt drive, by air, or under its own power, and in its own bearings for highest precision. Four speed ranges are available on any standard belt-driven machine. Positive plane separation is assured, even on extremely narrow parts, permitting a true dynamic balance within the machine's 10-microinch sensitivity range.

Machine pedestals are easily adjusted to accommodate any part from 1 3/16 in. to 8 in. long and up to 6 in. in diameter. Amount of unbalance is indicated on a meter, while its position is shown by a synchronous strobe light.

Tinius Olsen Testing Machine Co, 653 Easton Rd, Willow Grove, Penna

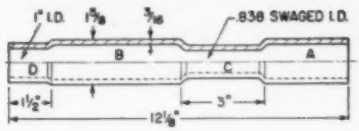
MORE DATA? Circle 78, inside back cover



Line of Press-Type Resistance Welders Offered in Four Sizes

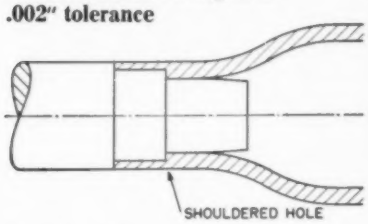
A new standard line of press-type resistance welders has machines in four sizes, from 30 to 500 kva. Each size

Swaging lowers costs



To bore and recess cavities A and B to provide tool runout for broaches or taps is a costly operation. It is simply and quickly done on a Torrington Electro-Hydraulic Die Closing Rotary Swager. Section C is closed in by the wedge-operated die using a mandrel to hold ID tolerances. Rate: 240 per hour. Section D is swaged by conventional operation of the machine at 350 per hour. Swaging over a mandrel often eliminates further drilling or reaming operations.

Shouldered hole swaged to .002" tolerance



Copper or aluminum accumulator tubes often require a shouldered hole of two diameters to provide for assembly of a connecting tube. Both diameters can be held to .002" by swaging over a shouldered mandrel. Swaging eliminates a drilling operation and produces a smoother and more accurate hole. Production rate on 1" tubes with 20° inc. angle is as high as 240 per hour.

Swaging forms long threads

Rotary swaging can conveniently thread long lengths. For example, the Model 211 Torrington Swager, running at 570 rpm on 32 pitch thread would turn out about 18 inches per minute with no chips. Swaging produces Class 2 threads, with one thread every spindle revolution.

Can ALL these parts be swaged?

YES—versatile swaging is faster and more economical!

These and many other operations can be done faster, more economically on a Torrington Rotary Swaging Machine—pointing, tapering, reducing, sizing, forming inside contours. Because swaging moves metal, many parts can be swaged in less time, using less materials without turning a chip. Applications of swaging are being extended daily by Torrington to answer production problems—saving money, improving tolerances and finish. Your Torrington engineer can show you new ways to swage many parts you are now machining. Make a note today to call him. The Torrington Company, Swaging Machine Division, North Street, Torrington, Conn.

TORRINGTON ROTARY SWAGING

Visit Torrington Design Engineering Show.
Philadelphia • May 25-28

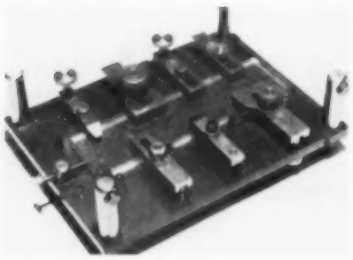
CIRCLE 270 READER SERVICE CARD

is available as a spot welder, a projection welder, or a combination spot and projection welder in a range of standard throat depths, electrode forces and transformer sizes.

Design features include one-piece space-saving frame, anti-friction slide, integral transformer and lower arm.

Federal Machine and Welder Co, Warren, Ohio

MORE DATA? Circle 79, inside back cover

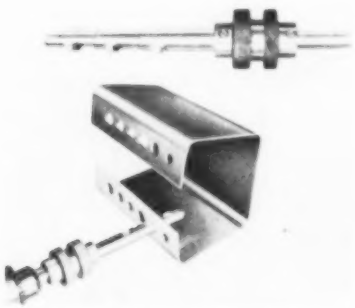


Jig and Fixture Plates Offered in Stock Line

Precision ground plates, 3/16, ¼, ⅜, or ½ in. thick, are available in stainless steel or aluminum. All surfaces are flat and parallel to within ±0.0005 with an over-all 32 mu-in. ground finish. Three shapes, square, round, and rectangular, in a wide variety of outline dimensions, are adaptable to all jig and fixture applications.

PIC Design Corp, 477 Atlantic Ave, East Rockaway, LI, NY

MORE DATA? Circle 80, inside back cover



One Tool Deburrs Both Sides Of Three Sizes of Holes

This tool, used in a portable drill motor, deburrs the front and back hole faces of three different size holes without separate tool changes. It is equipped with three pilot diameters and a retractable cutter blade with three correspondingly positioned cutting heads.

NoBur Mfg Co, 6860 Farmdale Ave, N Hollywood, Calif

MORE DATA? Circle 81, inside back cover

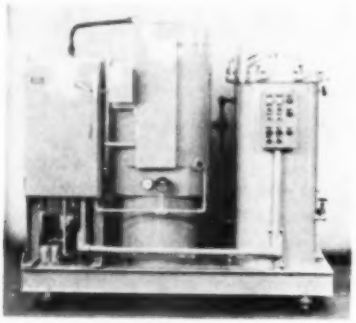
Pot Crucible Furnace Operates At Temperatures up to 2000 F

Unit is designed for heavy and continuous duty at all heat levels up to 2000 F. Versatility as a pot, crucible, and retort furnace makes it adaptable for a variety of laboratory and pilot plant operations.

Chamber is 8 in. in dia by 9 in. deep. Alloy pot dimensions are 6 in. ID by 10½ in. deep; atmosphere retort has a working area of 6 in. ID by 8¼ in. deep. Furnace is supplied as a complete unit with transformer, heating element, contactor, thermocouple, and chamber cover.

Lindberg Engineering Co, Pilot Plant Equipment Div, 2444 W Hubbard St, Chicago 12, Ill

MORE DATA? Circle 82, inside back cover



Oil Reclaimer Filters Hydraulic Oil at 100 gph

Model 100X Hilco Hyflow, designed for filtration of hydraulic oil on machine tools also incorporates a separate 16-gpm pump to filter the oil only.

Reclaimer system consists of all JIC electric controls, an inlet cellulose cartridge filter, inlet and outlet oil pumps, an outlet fuller's earth filter, vacuum filter, vacuum pump, and automatic draining distillate collection tank. All operation is automatically controlled for recirculation of oil on the vaporizer, permitting purified oil only to be delivered from the reclaimer. Automatic dumping distillate tank will drain collected distillate to the sewer when fluid level reaches a predetermined point.

Hilliard Corp, Elmira, NY

MORE DATA? Circle 83, inside back cover

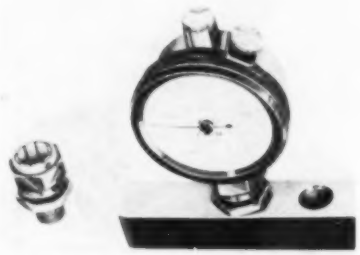
Talyrond Roundness Tester Introduced in Smaller Model

New Model 50 roundness measuring instrument (English) is said to provide accuracies of 0.000002 in. or better over a capacity of 12 in. ID or OD and 10-in. height. Unit can be used for individual or production inspection in analysis and control of automatic production of precision parts.

Talyrond spindle is built into a sturdy assembly that also contains the drive and true-coordinate straight line inkless polar recorder. Work in any convenient fixture can be located rigidly on the elevating table. Squareness and concentricity are checked with simple accessories.

Distributed by Engis Equipment Co, 431 S Dearborn St, Chicago 5, Ill

MORE DATA? Circle 84, inside back cover

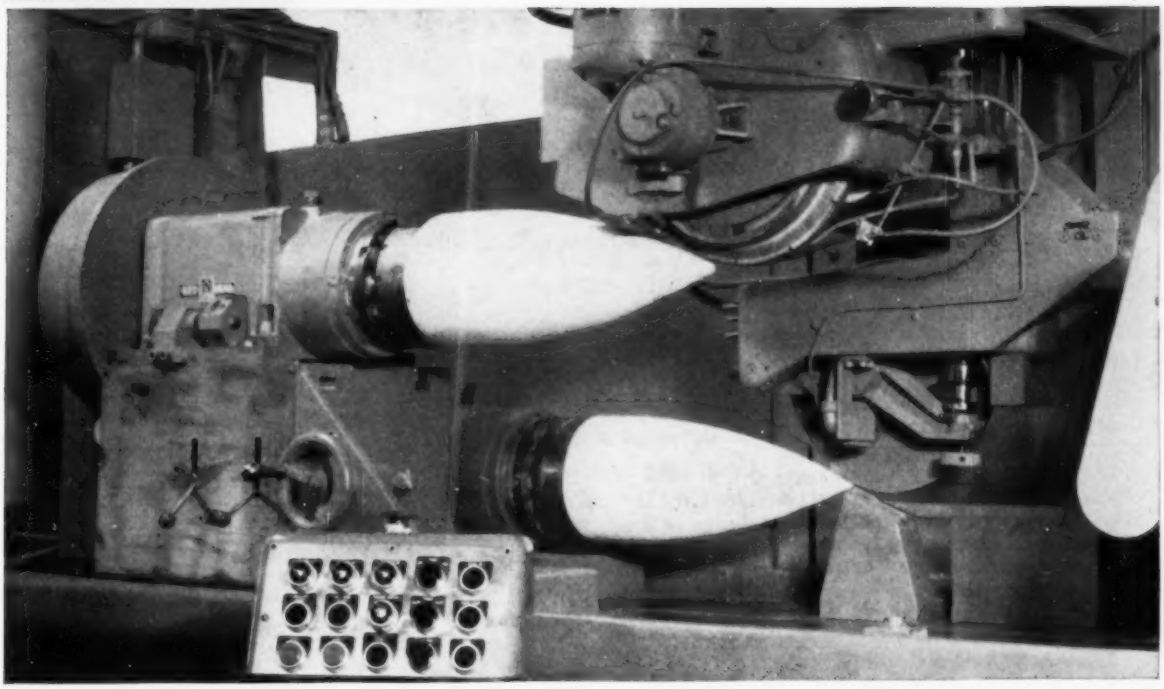


Depth Gage Includes Collet For Mounting Dial Indicators

Series of depth gages includes a spring collet that can also be used separately for mounting dial indica-

MATTISON
HIGH-POWERED PRECISION
GRINDING METHODS

New method of duplicating extremely accurate forms



Tracer-controlled grinder combines heavy cuts, close tolerances on super-hard ceramic nose cones

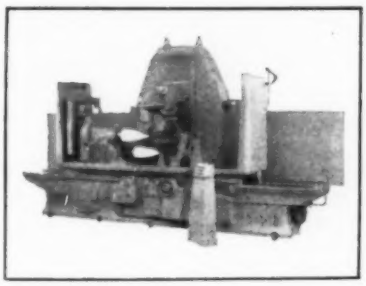
Looking for an accurate method of duplicating complex workpieces with a minimum of engineering, fixturing, or setup costs? This tracer-controlled surface grinder developed by Mattison in co-operation with a leading missile manufacturer may be the answer.

Missile engineers wanted a grinder that could remove up to .400 in. of super-hard skin from ceramic nose cones and still maintain critical wall thickness. The grinding wheel had to take a series of curvilinear cuts around an elliptically shaped cone. Wheel path had to be longitudinal to eliminate "banding" and minimize friction when the missile was in flight. The manufacturer wanted a machine that could be converted easily from missile requirements to conventional work.

Mattison started with a standard 30 x 30 x 72 in. horizontal-spindle grinder. On rugged jobs that put a premium on rigidity, this machine is made to order—its rigid double-column supports, heavy wheel housing, and solid, one-piece bed virtually eliminate all deflection and vibration, even under hogging cuts.

To this was added a direct, hydraulic, transfer-type tracer for smooth, stepless positioning of the grinding head.

In operation, table feed moves the tracer longitudinally over a precision-ground, hand-lapped master cone, transmitting the form to the grinding head. A diamond wheel "mirrors" tracer motions, takes successive cuts (up to .070 in. per pass) until cone is completed.



Although it is used here with a round master, the tracer works equally well on flat templates. For transverse cuts, the tracer wheel (or stylus) can be swung 90° and fed across the template using head cross-feed.

If *your* jobs require duplicating extremely accurate forms, why not investigate tracer-controlled grinding?

See Quick-Tilt surface grinding

On the new Quick-Tilt vertical-spindle surface grinder we are producing perfect cross-hatch finishes on large uninterrupted surfaces. We can show you production savings and accuracy improvements on test jobs or your own piece-parts. For all arrangements see your dealer or call:

MATTISON MACHINE WORKS
Rockford, Illinois • Phone WO 2-5521

MATTISON MACHINE WORKS
HIGH-POWERED PRECISION SURFACE GRINDERS

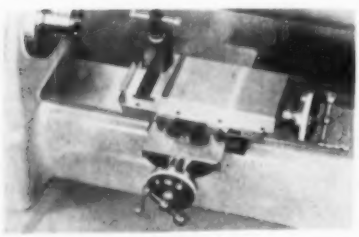
CIRCLE 271 READER SERVICE CARD

tors. They are available in two or three-hole models to check center or off-set depths.

Each gage has a ⅜-in. spring collet that will accommodate any AGD dial indicator. The collets, supplied with ⅜-in.—32 male thread, can be used to mount dial indicators on fixture gages, plate or angle blocks, or on bars used as depth gages for large diameter holes.

Petz-Emery, Inc, Pleasant Valley, NY

MORE DATA? Circle 85, inside back cover



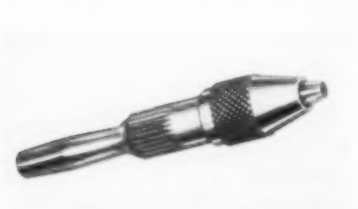
Compound Slide Rest Offered For Hardinge Precision Lathes

New model is equipped with a square body toolpost taking standard ⅜-in. square HSS or carbide toolbits. Post has an integral screw feed wedge arrangement for holding the toolbit and is reported to be fast, accurate, rigid, and particularly well suited for use with carbide tools.

Features include magnified settings for precise angular adjustment of the index slide; black and white feed screw dials to simplify working to close tolerances; completely covered feed screws that provide full protection against chips; quick-acting safety interlock for bed positioning and double lock arrangement for index slide.

Hardinge Brothers, Inc, Elmira, NY

MORE DATA? Circle 86, inside back cover



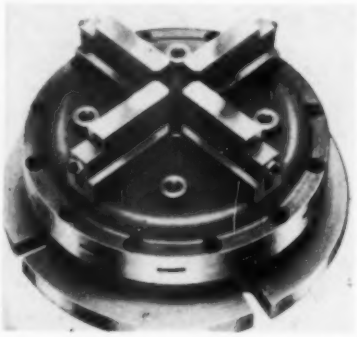
Wire Drill Chuck Available For Use With Dumore Micro-Drill

Chuck for wire drills from 0.006 to 0.020 in., designed for use primarily with the Micro-Drill, fits into the geared chuck of the tool or any drill-press with ⅛-in. capacity, and is quickly trued with the touch of the fingertip.

Hardened steel collet, slit four ways, holds the wire drills accurately in place. Chuck consists of tapered shank, a steel collet, and a knurled steel locknut. Unit increases the accuracy of deep hole drilling in this size range by eliminating any runout of drill or chuck, according to manufacturer.

Dumore Co, 1300 Seventeenth St, Racine, Wis

MORE DATA? Circle 87, inside back cover



Air Operated Diaphragm Chucks Claim Long Spindle, Bearing Life

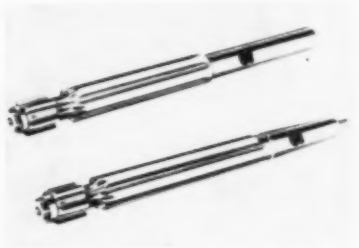
Line of air operated diaphragm chucks is said to give longer spindle and bearing life and permit higher production speeds.

The work part can be chucked either internally or externally. Air leakage is eliminated. Other features include quick-change diaphragm replacement, interchangeable jaws, and sludge slots in the periphery.

Three basic models in the new line are designated Model 5½ with capacity of ⅛ to 3 in. dia, Model 7 with capacity of ½ to 4¼ in. dia, and Model 10 having a capacity of 1 to 6½ in. dia. Piston areas are, respectively, 13.80, 24.74 and 49.68 sq in.

Crickson Tool Co, 34350 Solon Rd, Solon, Ohio

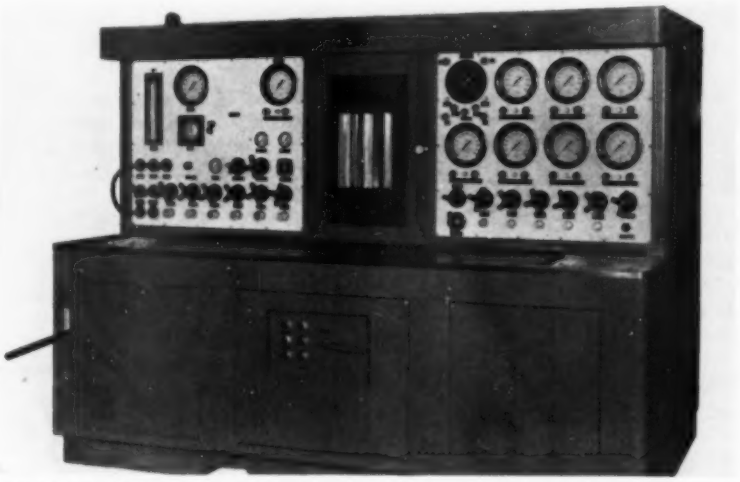
MORE DATA? Circle 88, inside back cover



Expansion Chucking Reamer Features Replaceable Shell

Carbide-tipped expansion chucking reamer features a replaceable shell that can be expanded to compensate for wear during use.

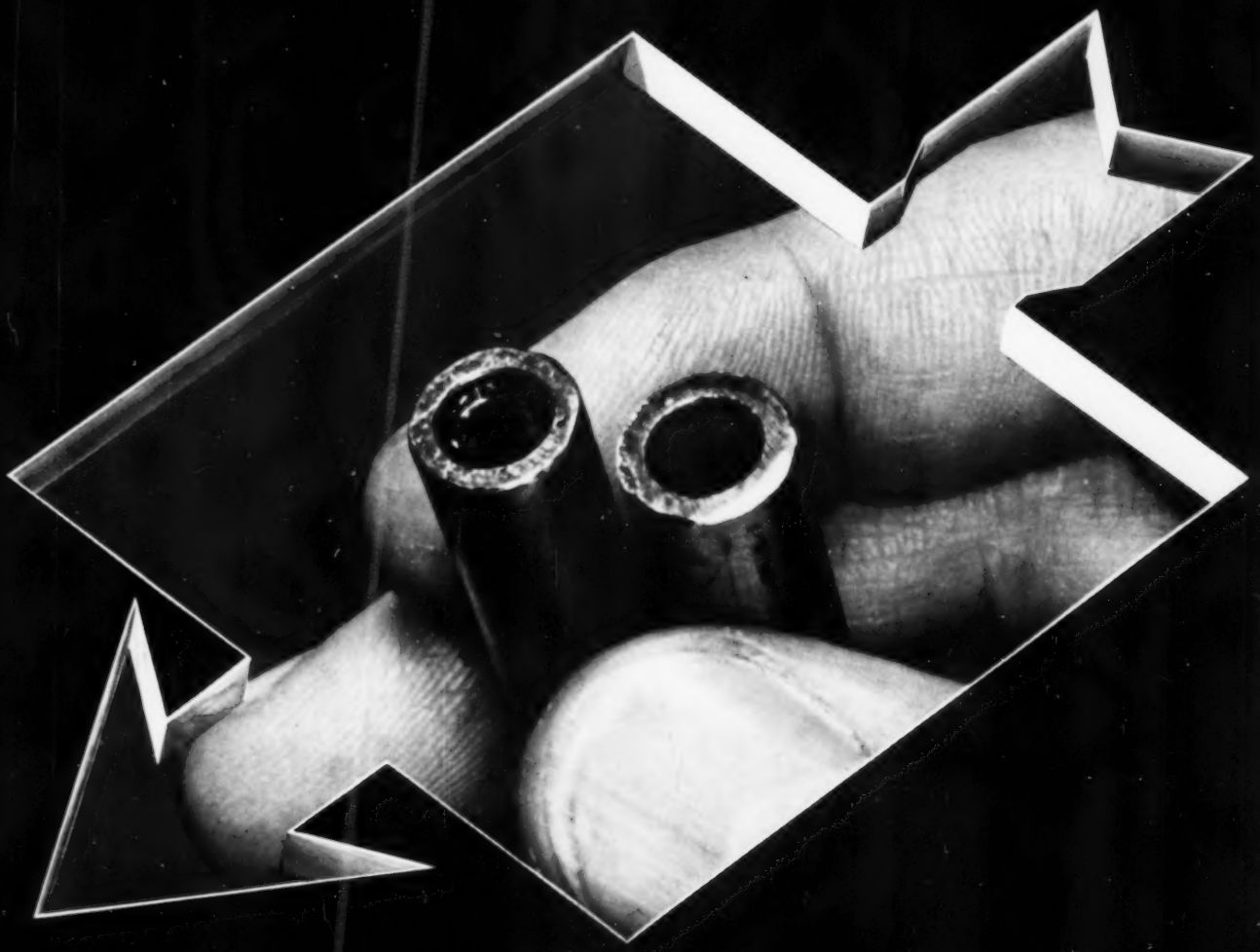
When the reamer needs expanding to offset wear, the shell is driven further onto the tapered arbor. The



HYDRAULIC MISSILE COMPONENTS are tested under simulated operating conditions on Model 9500 console, a self-contained laboratory instrument for static and dynamic testing. Automatically regulated high-pressure oil system delivers up to 20 gpm at 3000 psi, or 9.7 gpm at 5000 psi. Manually operated high-pressure source produces 20,000 psi for static testing. Automatic temperature regulating system controls test fluid temperatures to ±2 F from ambient to 350 F—*George L Nankervis Co, 15400 Fullerton, Detroit 27, Mich*

MORE DATA? Circle 89, inside back cover

Quality–the best economy of all



Two oils...two lines...one clogged...one cleaned

A Sunvis 700 oil and a regular oil were run through two equally clogged hydraulic lines. The regular oil couldn't remove the sludge. The Sunvis 700 oil cleaned its line thoroughly. That's one job it's made for . . . to clean out sludge deposits in hydraulic lines while it transmits power.

With a Sunvis 700 oil—like every Sunoco oil—you enjoy the best economy of all: the economy of quality. A Sunvis 700 oil lasts longer. The machinery it protects lasts longer. It prevents rust . . . ups output by reducing downtime.

FREE Trouble-Shooting Chart will help you spot and cure common hydraulic system troubles. For your copy, write to:

Sun Oil Company, Philadelphia 3, Pa., Department I-12.

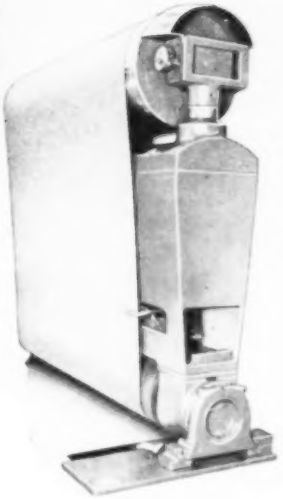
MAKERS OF FAMOUS CUSTOM-BLENDED BLUE SUNOCO GASOLINES

SUNOCO®

HILL Sheet and Plate polishing machine with reciprocating hydraulic table and vertical two roll head.

A HILL Polishing Machine of *YOUR OWN* will afford you important savings...

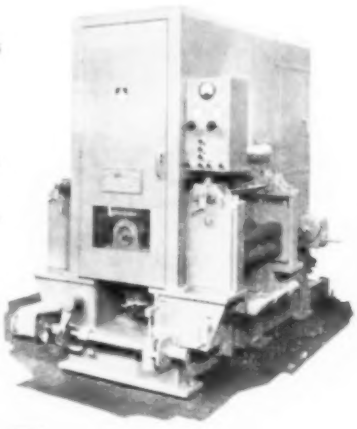
- *By eliminating mill extras.*
- *By proper finishing and prepolishing before forming.*
- *By enabling you to prepare the correct surface finish to meet each individual job need.*



IT'S MOSTLY IN THE HEAD

Two rolls accurately controlled for speeds and pressures with easy adjustment for proper tension of the endless abrasive belt. For fine finishing of all types of ferrous and non-ferrous metals.

● HILL polishing machines are now saving important percentages for manufacturers supplying the dairy and sanitation fields, for automobile bumpers, engravers plates and a wide variety of other industries.

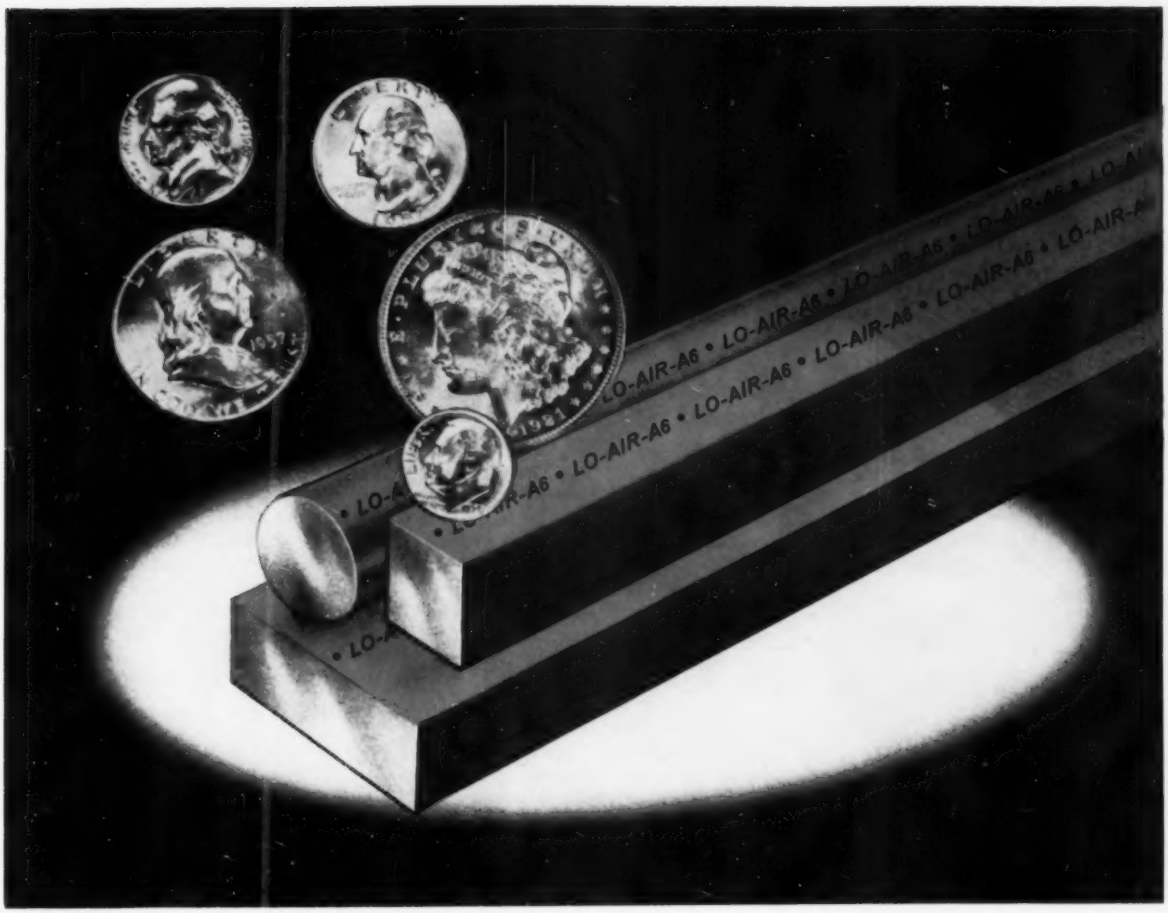


HILL Pinch Roll type with vertical two roll head for polishing strip. Can be used singly or in multiple units for line production.

The HILL ACME Company

1207 W. 65th STREET • CLEVELAND 2, OHIO

"HILL" GRINDING & POLISHING MACHINES • HYDRAULIC SURFACE GRINDERS • ALSO MANUFACTURERS OF "ACME" FORGING THREADING • TAPPING MACHINES • "CANTON" ALLIGATOR SHEARS • BILLET SHEARS • "CLEVELAND" KNIVES • SHEAR BLADES


LO-AIR-A6 • LO-AIR-A6 • LO-AIR-A6 •

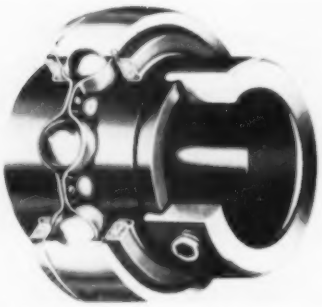
reamer will expand uniformly on all cutting edges, eliminating the need for grinding in most cases. When fully expanded and worn, the shell can be replaced.

The grooved rear pilot of the reamer is ground 0.0002 to 0.0004 in. under the cutting diameter. It can be supplied 0.010 in. undersize if piloting is not needed.

Replacement shells and expansion reamers with straight or tapered shanks are available in stock sizes from ½ to 1½ in. dia in 1/16 in. steps.

Standard Tool Co, 3950 Chester Ave, Cleveland 14, Ohio

MORE DATA? Circle 90, inside back cover



Machine Unit Bearings Feature Eccentric Collar Shaft Locks

Hoover machine unit ball bearings are now available with eccentric collar shaft locks. They are equipped either with spherical seat for automatic self-alignment or straight outer diameters for more rigid, accurate shaft location. Bearing units are furnished in 32 shaft sizes from ¾ in. to 2 15/16 in.

Hoover Ball and Bearing Co, 5400 S State Rd, Ann Arbor, Mich

MORE DATA? Circle 91, inside back cover

Safety Latch for Hoist Hooks Prevents Accidental Dropping

This safety latch will prevent accidental detaching or dropping of loads and can be fitted to any hoist hook in a few minutes with simple tools.

The device consists of a clamp-on collar and a spring-loaded safety latch which fits into the hook opening. Lugs on both sides of the latch make it possible to set or release the device without placing fingers in the hook opening.

It is available in three sizes, for ¼ to 3-ton units.

Harrington Co, Grabers Rd, Plymouth Meeting, Penna

MORE DATA? Circle 92, inside back cover

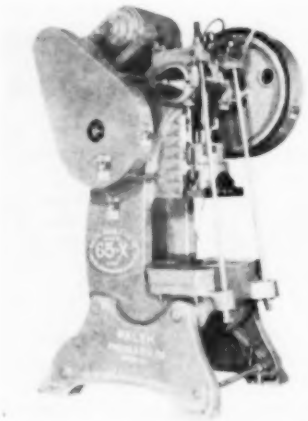
Automatic Programming System Introduced by Bendix

System for its Model G-15 digital computer is called POGO (program optimizer for G-15 operations). Using a set of simplified computer instructions, the programmer can write a POGO program with minimum of effort. When these instructions are fed into the computer the machine automatically rewrites the program in machine language instructions and stores them.

POGO commands are similar to those used for the Intercom 1000 interpretive system. Principal difference between the two systems is that the former compiles an optimum machine language program and reproduces it for later use.

Bendix Computer Div, Bendix Aviation Corp, 5630 Arbor Vitae St, Los Angeles 45, Calif

MORE DATA? Circle 93, inside back cover



65-TON DEEP THROAT OBI is the latest in the Walsh press line. This model, No. 65X, is a back geared press with multiple jaw or pin type clutch, variable speed drive, and automatic lubrication system. Delivery takes four to six weeks, FOB Chicago—*Walsh Press and Die Co, 4709 W Kinzie St, Chicago 44, Ill*

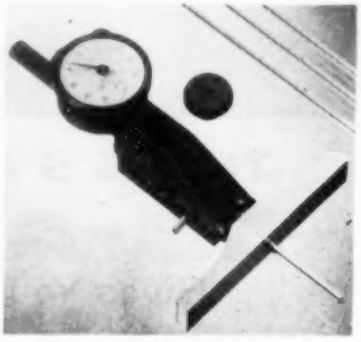
MORE DATA? Circle 94, inside back cover

36,000 and 40,000-lb Capacity Lift Trucks Added by Hyster

Challenger 360 and 400 added to line of pneumatic tire trucks have 6-cylinder Continental engine. Power plant develops 153 hp at 2400 rpm, 350 lb-ft of torque. Models have 3-speed range, power shifted, planetary transmission with integral torque converter.

Hyster Co, 1003 Myers St, Danville, Ill

MORE DATA? Circle 95, inside back cover



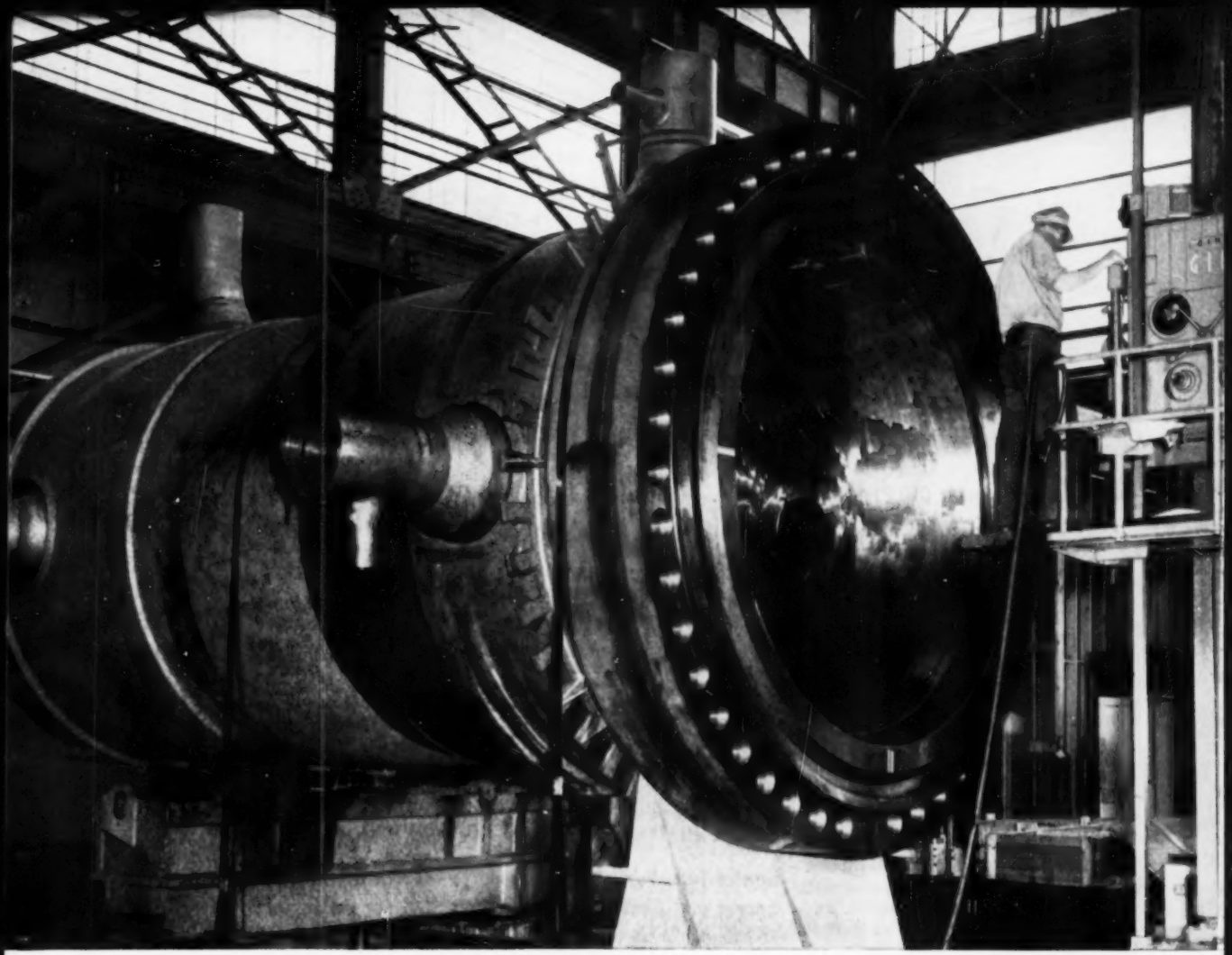
Double-Acting Depth Gage Simplifies Groove Location

Accurately locating internal or external grooves is said to be greatly simplified with this depth gage. A dial indicator accurately measures the travel of a footed rod and, in a single operation, gives the direct measurements for both the location and width of the groove.

A release pin on the side of the gage body permits measuring in either direction from the measuring anvil. Straight rods are also provided so that the instrument may be used as an ordinary depth gage. Both straight and footed rods may be changed in a few seconds.

Mueller Gages Co, Div of Mueller Laboratory, 1052 N Allen Ave, Pasadena, Calif

MORE DATA? Circle 96, inside back cover



Courtesy Combustion Engineering, Inc.

Combustion Engineering specified more than "ordinary boring mills"

Combustion Engineering, Inc., pioneer manufacturer of heavy reactor vessels, concluded that ordinary boring mills would not produce the close tolerances and surface finish required in their critical operations. That is why they specified a Cincinnati Gilbert floor type boring mill for this job.

The workpiece is a 96-ton stainless steel reactor for a Naval nuclear power plant. The Gilbert machine is used to finish the boring of the bolt holes in the 20" thick flange, and to machine the outlet nozzles.

Combustion Engineering's high standards require a surface finish of 32 R.M.S. on some of the bolt holes—an easy specification for a Gilbert, which can bore holes with a mirror finish, when required. A Tele-Vernier optical measuring system increases the speed and accuracy of machine positioning.

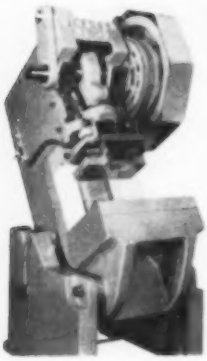
Work of equally high quality is produced on a number of other Gilbert boring mills at Combustion Engineering's Chattanooga and Windsor plants—proof that "those who buy Gilbert buy Gilbert again."

Write for new Bulletin 558.

The Cincinnati Gilbert Machine Tool Co., 3340 Beekman Street, Cincinnati 23, Ohio.

those who buy **GILBERT** *buy Gilbert again*

CIRCLE 275 READER SERVICE CARD



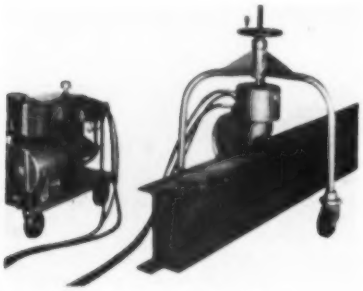
New Line of Minster OBI Presses Includes 35, 45, 60-ton Units

New features of Series 1 include a re-circulating lubrication system which can be furnished as an optional extra. System, enclosed within the press frame, continuously lubricates main and connection bearings, gibs, gears, and counterbalances.

Other features include modified flanged slide that gives larger die area; lower connection ball box adjustment consisting of a threaded takeup nut that quickly takes up a ball box clearance without dismantling the slide. Neoprene shield prevents foreign material from entering the ball box bearing and eliminates oil splash. Presses are equipped with combination air friction clutch and brake unit which provides torque overload control, greater tripping efficiency, and controlled cycling and inching.

Minster Machine Co, Minster, Ohio

MORE DATA? Circle 97, inside back cover



Portable Hydraulic Punches Permit On-the-spot Hole Forming

Line of portable hydraulic punches provide a method of hole forming in large or hard-to-handle pieces which eliminates awkward material handling.

They are available in a range of capacities from 5 to 90 tons. The 90-ton unit, illustrated, will punch up to 1 1/16-in. hole through ⅞-in. or 1-in. hole through 1 in. of mild steel.

A complete unit consists of punch with pushbutton control box, hydraulic power unit, and connecting flexible hydraulic lines. Punch units with 5 to 30-ton capacity are light enough to be carried from job to job. Heavier units of 50, 70, and 90-ton capacity have the power unit mounted on a cart and the punch unit suspended from a tripod.

W A Whitney Mfg Co, Rockford, Ill

MORE DATA? Circle 98, inside back cover

Gantry-Type Furnace Hardens Rocket and Aircraft Components

Hardening furnace with bottom loading and discharging, spanning a pit containing an atmoshpere quench chamber, salt quench tank, rinse tank, and draw furnace has been built for Lindberg Steel Treating Co.

Furnace shell, 11 ft in diameter by 35 ft deep, will handle a loading fixture with an effective work load 24 ft long by 6 ft 8 in. in diameter. Heating elements used for temperatures to 2050 F are mounted on the refractory in tiers so as to provide 500 kw in five zones of control. Furnace is mounted on four wheels on 18-ft centers with rails that allow it to travel along the 57-ft length of the pit.

Lindberg Engineering Co, 2450 W Hubbard St, Chicago 12, Ill

MORE DATA? Circle 99, inside back cover

Steel Alloys Withstands Stress, Corrosion, High Temperatures

Super-Rustfree steels are reported to withstand high temperatures, stresses, and severe corrosion, but cost considerably less than the super alloys and use no critical metals such as cobalt, columbium, or tantalum.

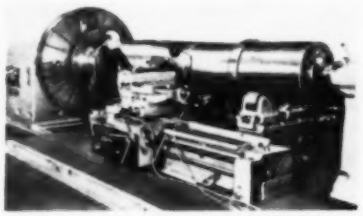
SR steels, developed by Uniworld Corporation of America, have a higher short time strength than the stainless grades at temperatures of 1200 to 1600 F. Alloy IIA-1132 stands a stress of 30,000 psi for at least 1700 hours at 1200 F, and at the same temperature has a higher stress to rupture strength then Rex 326 and G18B alloy.

At room temperature this alloy has, as cast, a tensile strength of 82,000 psi and yield strength of 60,000 psi and can be age hardened to a tensile strength of 120,000 psi and yield strength of 105,000 psi.

SR steel alloy UST has, at 1600 F, better stress to rupture properties than stainless 330.

Kolcast Div, Thompson Ramo Wooldridge, Inc, Cleveland, Ohio

MORE DATA? Circle 100, inside back cover



German Faceplate Lathe Designed For Large, Light Workpieces

Ravensburg faceplate lathes are said to be most economical in turning and facing of large diameter workpieces such as missile bodies, generating plant, mining and shipbuilding equipment.

The lathes, made in West Germany, have separate headstock, baseplate, and bed units which can be built for specific requirements. Headstocks are available with a 12-18 step gearbox or with stepless speed variators.

Saddle and cross-slide feed is available in either in. per min or in. per rpm. Feed gear drive originates from the main gearbox by means of a special electrical shaft system that eliminates mechanical connection between bed and headstock.

Turning diameter over baseplate is 80 to 110 in., with a greater diameter possible with use of a pit. The lathe will accommodate unsupported workpieces from 6500 to 20,000 lbs., having a center of gravity 12 in. from the faceplate.

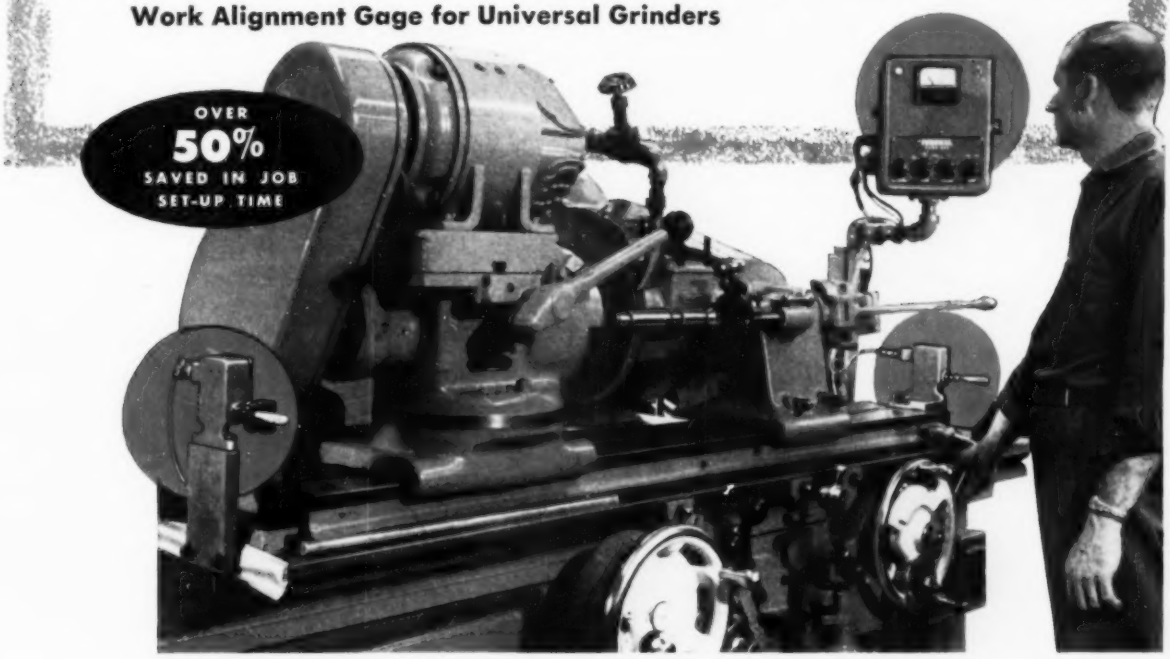
Imported by Cosa Corp, 405 Lexington Ave, NY 17, NY

MORE DATA? Circle 101, inside back cover

the Sure-set

FAST ACCURATE ABSOLUTE

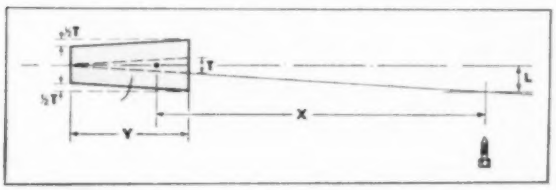
Work Alignment Gage for Universal Grinders



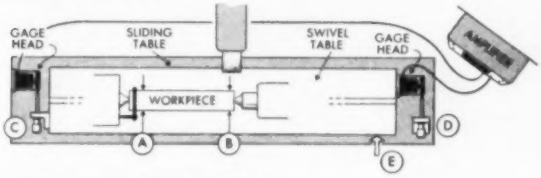
HOW THE SURE-SET PROVIDES *ABSOLUTE* CONTROL OVER WORK POSITIONING

(1) The Sure-Set is an electronic work-positioning gage which guides the operator in making the *exact amount* of swivel table adjustment needed to eliminate unwanted taper or — conversely — to produce a specifically desired taper, so that a part can be produced successfully *WITH ONLY ONE TRIAL CUT*. There is no restriction on workpiece length or table length.

(2) The Sure-Set shows the operator when he has made the table adjustment correctly by showing actual table position. And, because it shows how much *each end* of the table moves, the operator can make correct adjustment, EVEN THOUGH THERE IS PIVOT LOOSENESS, STICK-SLIP, OR ACTUAL BENDING OF THE TABLE . . . conditions which occur in MOST grinders.



(3) The Sure-Set electronically compensates for the difference between length of workpiece (Y) and the distance from table pivot to adjusting screw (X). This is important because it permits the operator to make the correct table adjustment (L) without first having to stop and calculate what it actually should be. The Sure-Set is able to save the operator this calculation by charts, graphs, and mathematics because its meter (graduated in .001" or .0001") reads in terms of the workpiece taper (T) which he already knows.



A HARD JOB MADE EASY

The Sure-Set saves over 50% set-up time by eliminating trial-and-error grinding and repeated checks. Here is the procedure: Take trial cut . . . gage work at two points (A and B) to determine taper . . . set compensating switch on Sure-Set amplifier to match distance between A and B points . . . watching meter on amplifier, zero each gage head by adjustments at C and D . . . adjust swivel table at E until meter reading for *each* gage head matches the amount of taper . . . TAKE FINISH CUT. Total elapsed time — 2 to 3 minutes!

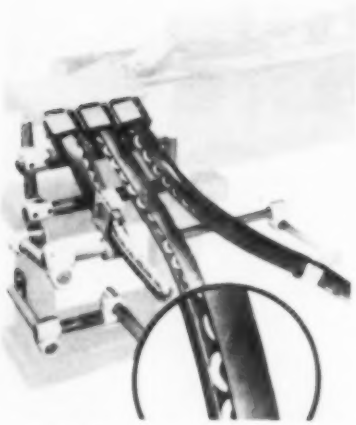
You'll be amazed how much time and money the Sure-Set can save! For further information contact your local FEDERAL representative or write . . .

FEDERAL PRODUCTS CORPORATION
9124 Eddy Street, Providence 1, R. I.

Ask **FEDERAL** *First*

FOR RECOMMENDATIONS IN MODERN GAGES . . .

Dial Indicating, Air, Electric, or Electronic—for Inspecting, Measuring, Sorting, or Automation Gaging



Standard Fittings Can Be Used To Install Flexible Feed Track

Open-Flex track, adaptable to most feed track operations, can be installed with standard fittings and clamps. Its flexibility permits tracking through crowded machine areas

Fabricated in a wide variety of shapes and sizes, the flexible track can be used in the continuous feeding of reciprocating equipment. The flexible covering of the internal carrier wire is impervious to abrasion, acids, oils and heat to 175 F.

Campbell Machines Co, 1863¼ Fitzpatrick St, Detroit 28, Mich

MORE DATA? Circle 102, inside back cover

Portable Elevator Features Hinged Tower for Low Ceilings

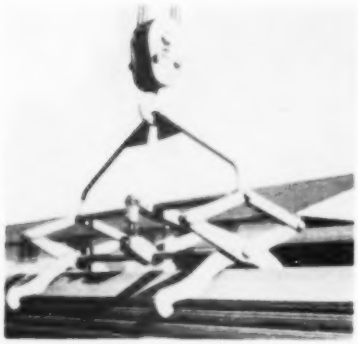
A hinged tower on this light-duty portable elevator permits it to pass through 6½-ft doorways and operate in close quarters.

With the tower extension at full height, the lifting platform can be raised to 90 in. When folded the tower affords lifts up to 55 in.

The Model 90 lifts loads up to 1500 lbs at 13-in. load center. It is equipped with a 12-v battery, battery recharger, charging indicator light, chrome-plated piston, and a hydraulic cylinder with flow return control valve. A 2000-lb capacity model is also available.

West Bend Equipment Corp, West Bend, Wis

MORE DATA? Circle 103, inside back cover



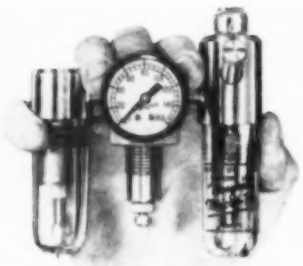
Crane Tong Handles Steel Sheet Piling Automatically

A materials handling tong, called the American Cranehand, automatically lifts and deposits steel sheet piling within crowded stock areas.

Made of heat-treated alloy steel, the tong weighs 125 lbs, and has a capacity of 2000 lbs. It handles three different piling shapes, USS Nos. MP112, MP11b and MP116 or equal, in bay areas with as little as six inches space leeway. Single length piling up to 60 ft can be carried. No manual hooking is required.

American Forge and Mfg Co, McKees Rocks, Penna

MORE DATA? Circle 104, inside back cover



Compact Lubricating Units Introduced by Norgren

Two new Lubro-Control Units provide complete and efficient processing of compressed air for service to air cylinders, air chucks, air tools, bearings, and other machine components. They are available for air flows from 0.05 to 20 cfm. Smaller model, for ⅛-in. pipe installation, measures 4½ in. wide, 4¾ in. high, and 3 in. deep. Slightly larger unit for ¼-in. pipe is 7¼ in. wide, 5½ in. high, and 3¾ in. deep.

Each unit consists of an air filter; a pressure regulator, adjustable over a range of 5 to 100 psi; and a Micro-Fog Lubricator. Max line pressure is 150 psi; max regulated pressure, 100 psi; max operating temp, 120 F.

C A Norgren Co, Englewood, Colo

MORE DATA? Circle 105, inside back cover

Portable Vapor Degreaser Cleans Up to 300 lbs of Steel Per Hour

The Scotsman is all electric and requires no installation; it may be connected to any 220-v outlet for immediate use. Model incorporates a heavy-duty vapor control and high-temperature shutoff to eliminate fire hazard. Immersion heater is removable for easy clean-out. Zinc-coated steel tank has a solvent capacity of six gallons.

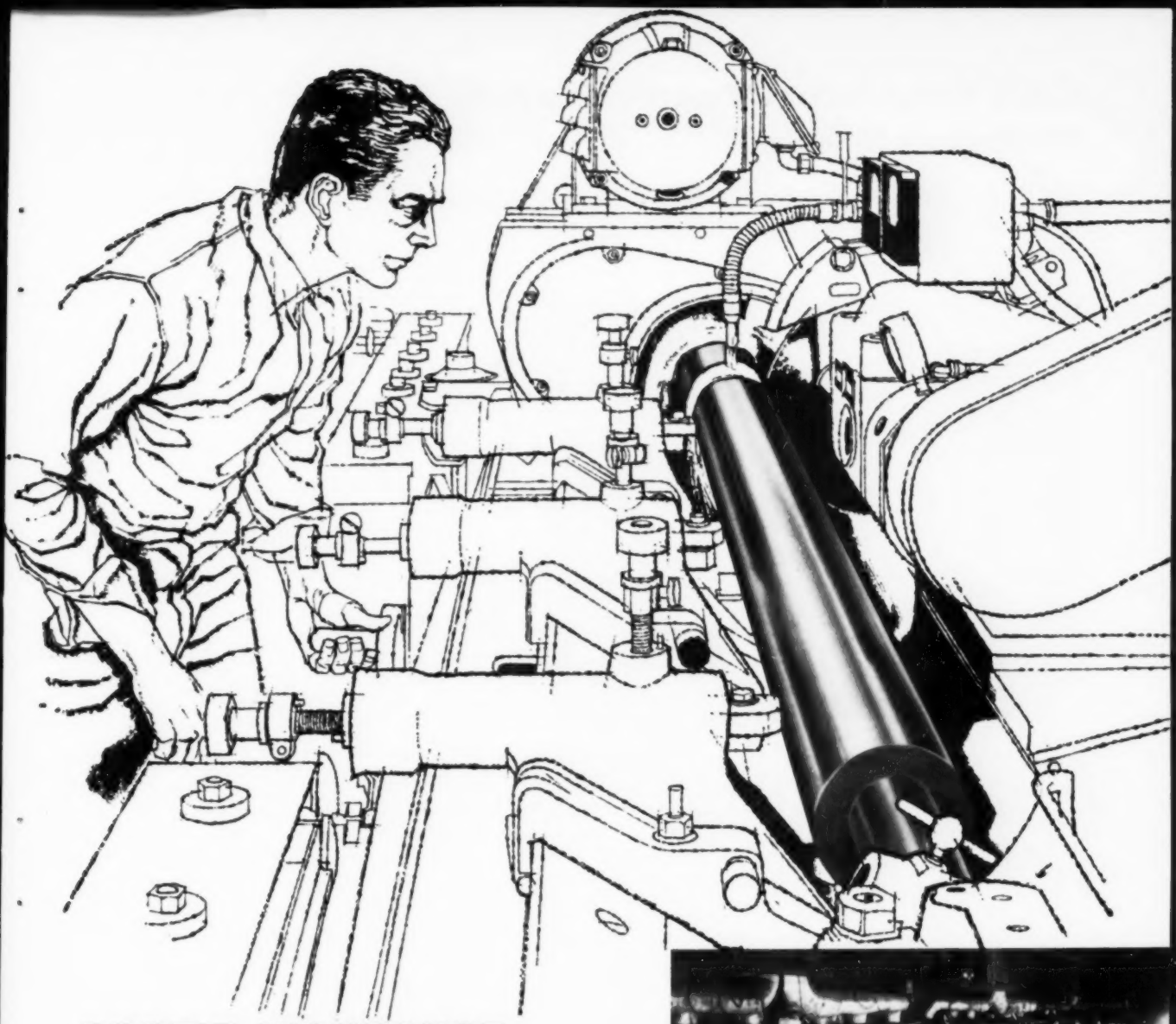
Phillips Mfg Co, 3475 Touhy Ave, Chicago 45, Ill

MORE DATA? Circle 106, inside back cover

New Barrel Finishing Media Makes Rapid, Clean Cuts

Honite brand C-R Tumbling Shape, composed of aluminum oxide mineral anchored in a 3M-developed binder, is a truncated triangular pyramid with sharp edges and acute angles that work into radii not reached by other types of media. Cutting speed of the new shape is reported by the manufacturer to be up

CIRCLE 277 READER SERVICE CARD ►



PROFIT INSURANCE
with J&L Stainless Steel Bars

Your machining costs on stainless steel bars are part of your investment for profit. Add your costs for tooling, handling and polishing, and you multiply your investment, often many times over.

Scrapping a single bar wipes out that investment—and with it most of your profit on a large volume of finished goods.

Every step taken to reduce rejects helps insure profits! The biggest step you can take in that direction is to specify J&L **Consistent** Quality on all orders for stainless steel.

J&L leads the industry in melt shop standards for stainless steel —the point where quality starts, **and your profit insurance begins.**

Careful attention to every production detail is the key to J&L quality

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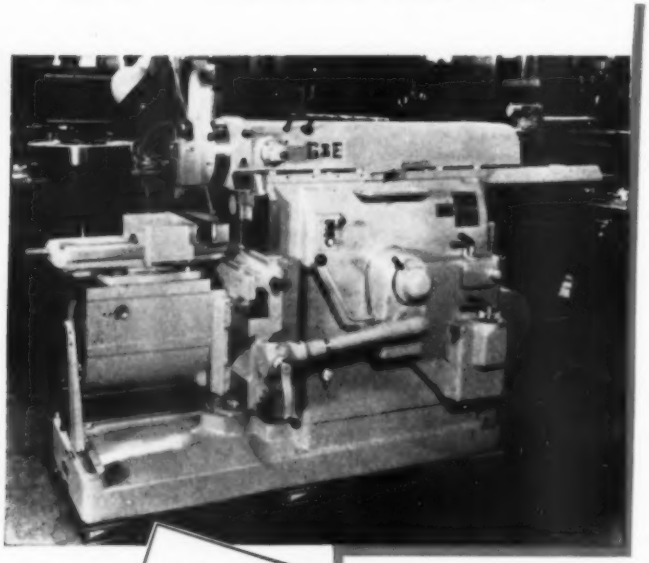
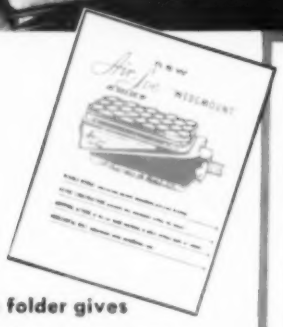
STAINLESS
SHEET • STRIP • BAR • WIRE

Jones & Laughlin Steel Corporation • STAINLESS and STRIP DIVISION • Box 4606, Detroit 34

Can You Hold Your Shaper Without Bolts?

YES- with new WEDGMOUNT which anchors Shapers, Presses, etc. *and* permits precision leveling!





Free folder gives complete facts about

WEDGMOUNT with—

"Air-Loc" patented vinyl, sisal and cork pads top and bottom grip machines to floors

•

double-wedge construction which permits immediate precision leveling

•

keyed construction which prevents movement within the mount

•

sizes available thru distributors, and prices

This Gould & Eberhardt 24" Industrial Universal Shaper, operating at 120 cuts per minute with a 4" stroke, is installed without bolts on a new type machinery mount called WEDGMOUNT. A dial indicator at the base of the shaper showed a total oscillation of only .022" during operation, and no "walking." The 7,800 lb. machine is installed on six WEDGMOUNTS, each type 3" x 6" S. Before operation, precision leveling is achieved by simple adjustment of a bolt within each mount. Top and bottom of each mount is surfaced with patented "Air-Loc" pads, which provide the high degree of friction required to hold the machine in place despite its strong lateral thrust.

Air-Loc® WEDGMOUNT

write to... **Clark-Cutler-McDermott Co.**

100 West Central Street • Franklin • Massachusetts

to 2½ times faster than existing aluminum oxide chips, and as much as 12 times faster than natural stone media.

In addition to faster cut and lighter weight, new shape is said to offer noticeable reduction in contamination of workpiece surface by metallic and mineral residue, producing a lightness of color not possible to duplicate in a single run with usual media.

Minnesota Mining & Mfg Co, 900 Bush Ave, St Paul 6, Minn

MORE DATA? Circle 107, inside back cover

Plastic Protector Available For Multiple Spindle Tools

This multiple head protector, made of neoprene-base materials, can be used for multiple die punch presses, multiple head drilling and tapping machines, and similar automatic machine tools.

The protector consists of independent protective sleeves assembled as a unit with a flange-mounted ring. They can be supplied in a wide variety of diameters and extended lengths.

A and A Mfg Co, Inc, 712 S 12th St, Milwaukee, Wis

MORE DATA? Circle 108, inside back cover

Socket Head Cap Screw Wrench Reaches Hard-to-get-at Places

This tool, called the Socket Head Cap Screw Universal Wrench, was developed to reach places normally inaccessible by standard Allen

ALL-NEW ALEMITE "77" LUBRICANT PUMP

packs most power

FOR HIGHEST PERFORMANCE!

68% More Powerful . . . outperforms any other air-operated lubricant pump of its class on the market today! The all-new 5.2 horsepower Alemite "77" Pump assures smoothest, fastest delivery of all lubricants, through longest lines!

Three Master Pressure Ratios for unequalled delivery of all lubricants – fluid, semi-solid and heavy fibrous types. Lightweight, rust-proof aluminum construction.

Precision Engineered from finest quality materials–designed for outstanding ease of operation and maximum performance. Models for 120-lb. or 400-lb. drums – for all industrial applications.

All-New Alemite "77" Features!

• **Volume Air Distributing Valve**–self-seating, self-cleaning, volume porting • **Modern-Design, Highly Efficient Toggle Trip Mechanism** provides balanced pressure on shuttle . . . won't bind • **Straight-Line Exhaust** has extra-large port for highest pump efficiency • **Hardened Steel Piston and Cylinder,** lapped to a precision fit of 125 millionths of an inch • **All-Steel Primer Valve,** ground to a perfect seal . . . hardened for abrasion resistance • **Dynamic Primer** assures priming and pumping of heaviest lubricants.

THREE POWERFUL "77" MODELS

• **High-pressure** (40 to 1 ratio) for light-bodied and fibrous greases. Delivery on both up and down stroke.

• **Medium-pressure** (25 to 1 ratio) for heavyweight oils and light-bodied greases. Delivery on both up and down strokes.

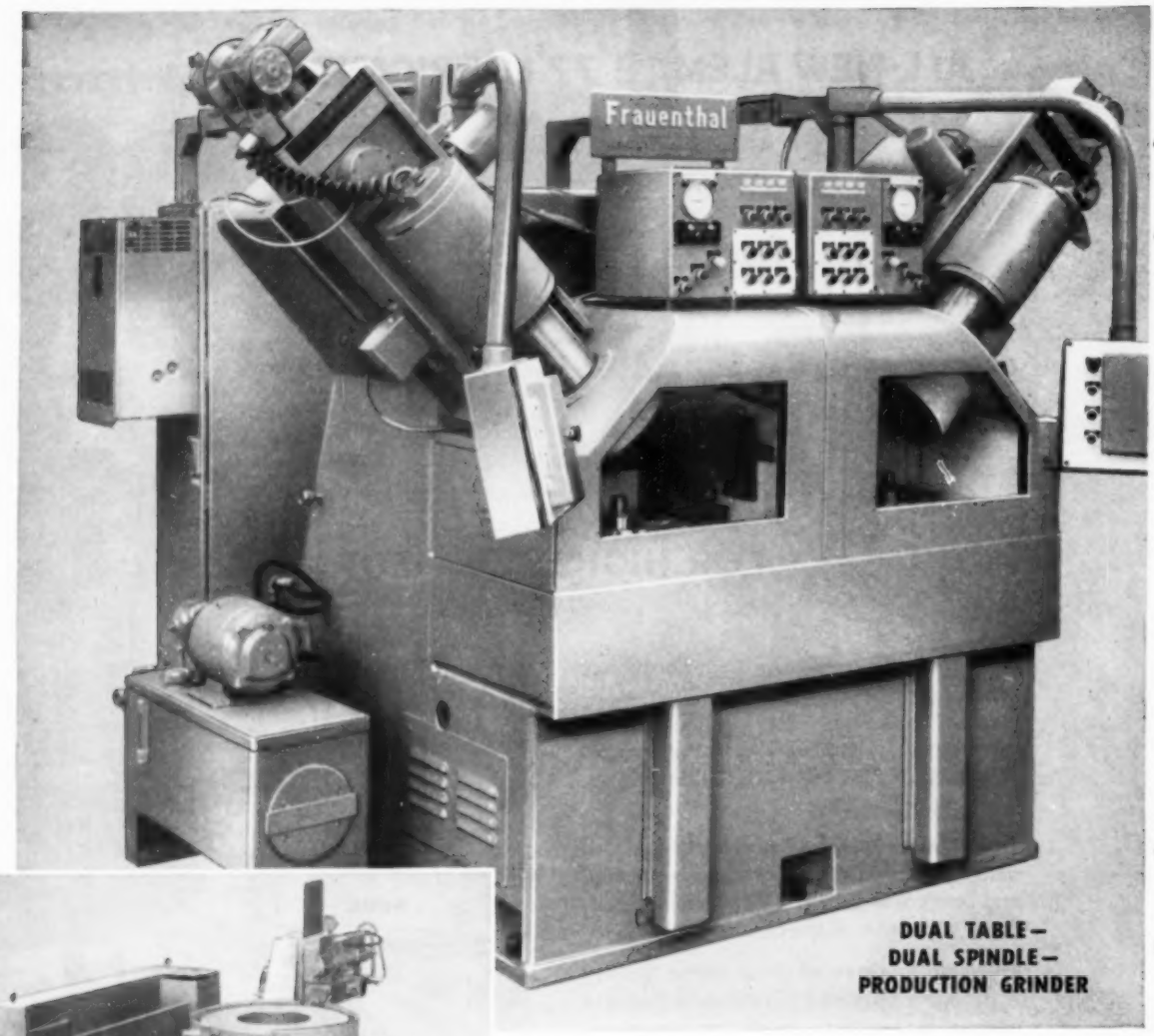
• **Volume delivery** (6 to 1 ratio) for light-bodied fluid lubricants. Single-acting pump mechanism.

Write for New Alemite "77" Pump Catalog!

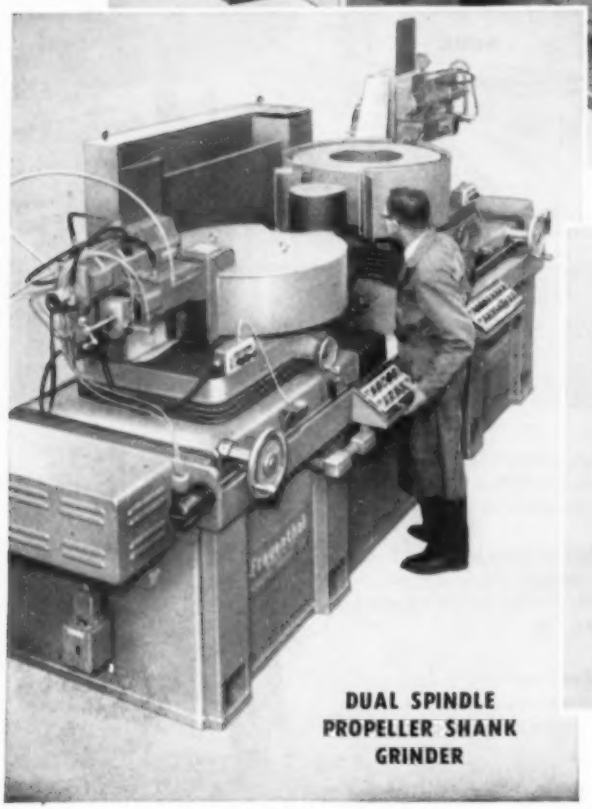
Symbol of SW Excellence

ALEMITE
DIVISION
STEWART-WARNER
CORPORATION

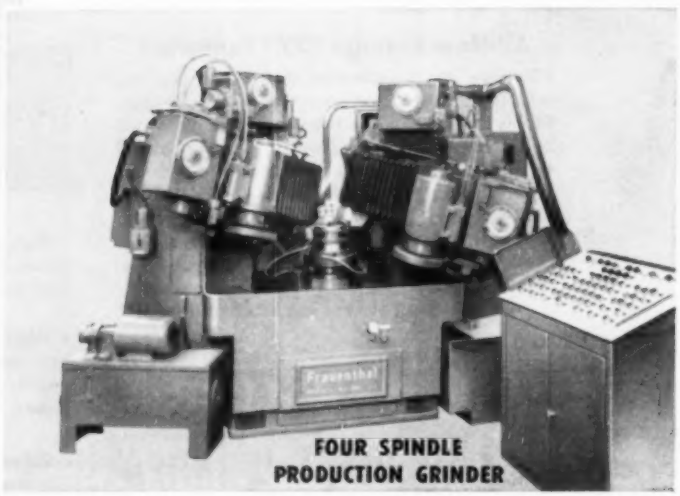
Dept. F-49, 1850 Diversey Parkway, Chicago 14, Illinois



DUAL TABLE—
DUAL SPINDLE—
PRODUCTION GRINDER



DUAL SPINDLE
PROPELLER SHANK
GRINDER

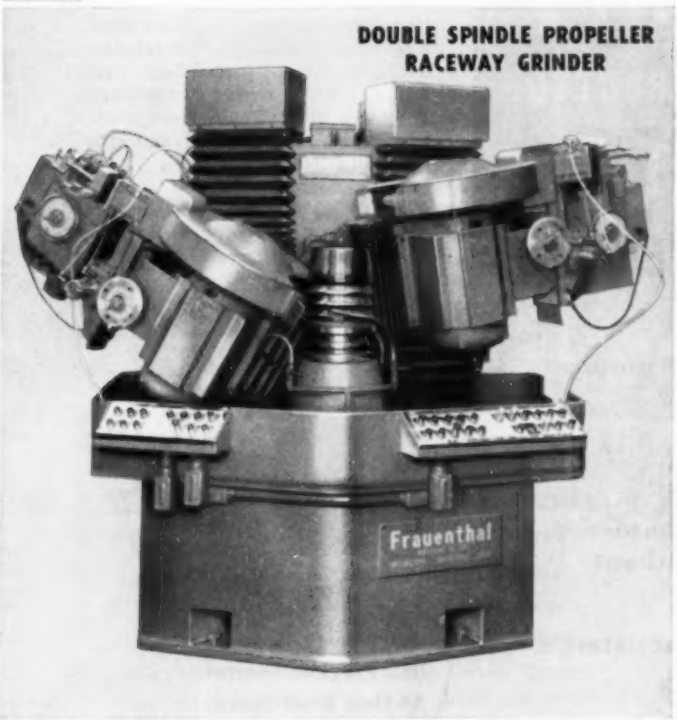


FOUR SPINDLE
PRODUCTION GRINDER

NEW PRODUCTION GRINDERS

Here's custom grinding at standard machine costs

F-900 Series Standard Slide Units . . . already successfully applied to exacting automotive and aircraft production . . . offer low-cost grinder specialization for general industry



DOUBLE SPINDLE PROPELLER RACEWAY GRINDER

It's no longer necessary to purchase several standard machines to accomplish a particular grinding job. Now Frauenthal offers an *economical* solution with production grinding machines equipped with F-900 Series Standard Slide Units. Simplified in design, tailored to *your* grinding requirements, tolerances of .000200" are held even with modern metals such as high-temperature alloys.

Special machines? Yes, in a sense. But comprised largely of proven, versatile Frauenthal-designed *standard* components. Single- or double-action standard slide units — either mechanically or hydraulically actuated — are applied to a machine base and drive assembly. Result: a grinder custom-engineered for *your* workpiece and operations.

Foremost consideration is given to reduced labor costs, ease of operation and maintenance, and economical use of floor space.

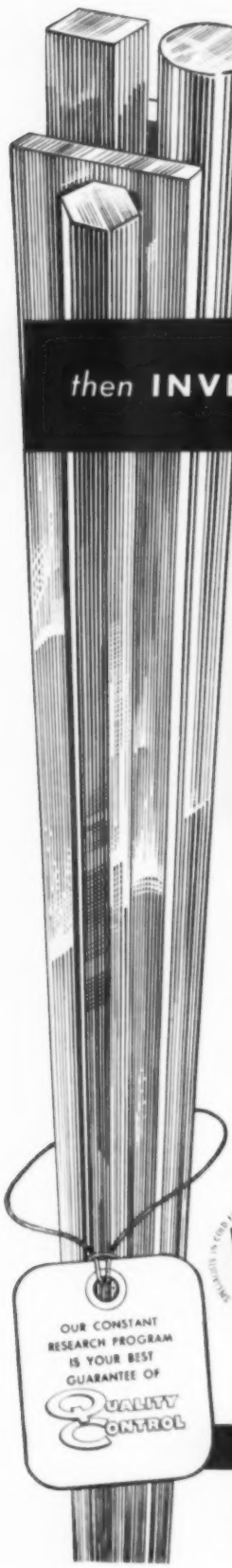
Virtually any degree of automation is available — not only for the large, but also for medium-sized plants, too.

The cost? Remember we offer specialized machines built largely from standard components — eliminating heavy design charges. The price will be a pleasant surprise — far below what you would normally expect to pay for a custom-designed machine. 2-58

Frauenthal Division

THE KAYDON ENGINEERING CORP.

MUSKEGON, MICHIGAN U. S. A.



Want
Positive Uniformity
in your **COLD FINISHED STEELS?**

then **INVESTIGATE**

WYCKOFF
CARBON CORRECTED
STEELS

THEY PROVIDE:

1. **Predetermined and uniform microstructure**
2. **Excellent machinability for the grade**
3. **Can be induction hardened to full hardness without metal removal**
4. **Optimum fatigue resistance**

OUR CONSTANT RESEARCH PROGRAM IS YOUR BEST GUARANTEE OF QUALITY CONTROL

WYCKOFF STEEL COMPANY
GENERAL OFFICES:
Gateway Center, Pittsburgh 30, Pa.
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Chicago, Ill., Newark, N.J.—Putnam, Conn.

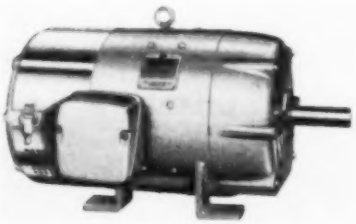
WYCKOFF STEEL PRODUCTS • Carbon, Alloy and Leaded Steels • Turned and Polished Shafting • Turned and Ground Shafting • Large Squares • Wide Flats up to 12¾" x 2¼" and 14" x 1¼" • All types of Furnace Treated Steels including Carbon Corrected Steels

wrenches. Available in five sizes, it permits a full turn without resetting the wrench in the cap screw head.

Over-all length of the wrenches, which have an integral handle and universal, is approximately 5¼ in.

Abington Machine Co, 8824 Alpine Rd, Detroit 4, Mich

MORE DATA? Circle 109, inside back cover



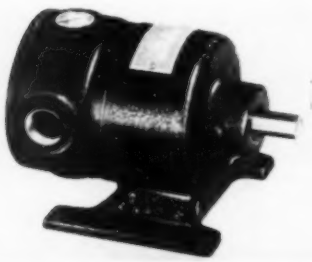
Line of Compact DC Motors Has Fast Response, Wide Speed Range

New line of dc motors, called Flexitorq motors, provides fast response, wide speed range, and high overload capacity in a light compact unit. They are available in ratings of 1 to 200 hp, in drip-proof and drip-proof guarded enclosures.

The motors are designed to supply constant or adjustable speed for driving machine tools, metal rolling, drawing or forming machines.

Louis Allis Co, Dept P, Milwaukee 1, Wis

MORE DATA? Circle 110, inside back cover



Unit Provides Control At Slow Shaft Speeds

An internally geared shaft failure indicator, called the 8000 Series Dazic, provides electrical signal control when driven by direct coupling to shafts turning less than 10 rpm and will operate from shafts turning as slowly as 2 rpm.

It is available in three ratios: 10, 5, and 2 to 1, and is provided with single pole, double-throw snap action contacts rated at 10 amps at 125, 250, or 460 v ac.

Winterburn Mfg Co, Putnam, Conn

MORE DATA? Circle 111, inside back cover

introducing a

NEW

OLOFSSON

HEAVY DUTY PRECISION BORING MACHINE

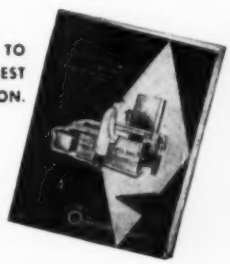
Designed for better precision finishing...semi-finishing...and roughing of large, bulky parts

This newest in the line of Olofsson Precision Boring Machines, the Model 22, is designed for more profitable heavy-duty rough and finishing boring, facing, chamfering, turning and grooving operations. Put one to work . . . and profit potential goes up. Because of the versatility of its new design, operating costs go down.

MODERN, WITH 22 QUALITY-DESIGN FEATURES, the Olofsson Model 22, weighs a hefty 7,600 lbs., untooled; and incorporates such design features as:

- *Extremely low ratio, height to width, of spindles to ways.*
- *Hardened and ground Alloy Steel flat and vee ways.*
- *Extra-large fixture mounting provides maximum stability for mounting large work pieces.*
- *Integral chip chutes completely surround any fixture tooling.*

WHATEVER YOUR PRODUCTION REQUIREMENTS, IT WILL PAY YOU TO FULLY INVESTIGATE THE MODEL 22. CONTACT YOUR NEAREST OLOFSSON REPRESENTATIVE. Or, if you prefer, write direct to OLOFSSON.



THE OLOFSSON

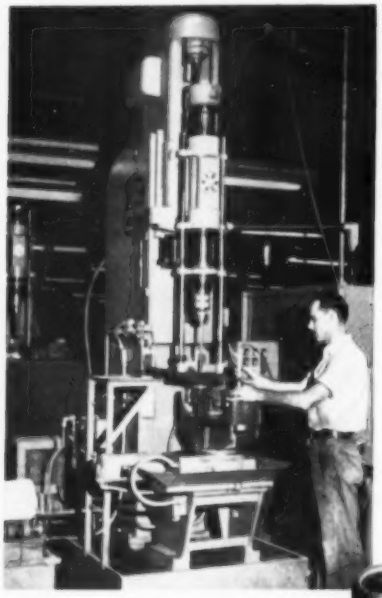
2728 LYONS AVENUE, LANSING, MICH. Phone: IV anhoe 4-5381

MANUFACTURERS OF PRECISION BORING AND SPECIAL MACHINERY

CIRCLE 283 READER SERVICE CARD

WHY Emerson Electric MICROHONES Laminated Steel Rotors

The Emerson Electric Manufacturing Company is constantly searching for the best possible processing methods. Working with Micromatic engineers on problems encountered in processing shaft holes in their laminated steel rotors, Emerson Electric found that Microhoning would provide much higher production quality while lowering processing costs. The following Microhoning benefits are now obtained:



Model 728 Hydrohoner with automatic Microsize, Microdial and two station rotary indexing fixture. Hole Tolerances: Diameter .0002 inch, straightness and roundness .0001 inch.

CUT REJECTS
With former processing method rejects ran too high. Microhoning controls size and assures a clean hole—rejects are substantially reduced.

ELIMINATED OPERATIONS
Old processing method required two operations. In one operation, Microhoning generates size and straightness within specified tolerances.

REDUCED BALANCING TIME 70%
To preclude vibration and poor operating characteristics, it is essential that shaft hole be concentric with O.D. of rotor. Microhoning reduced by 70% the amount of dynamic balancing correction required.

PROCESSING COSTS CUT 70%
Current figures show the cost of Microhoning shaft holes in rotors to be less than 30% of processing by old method.

Rotors (from 2¼ to 4 inches long) are all Microhoned on the same machine by changing adaptor in fixture and resetting stroke length.

Learn why Microhoning will give you efficient stock removal, closer tolerances, accurate alignment and functional surfaces.

☐ Please have a Micromatic Field Engineer call.
☐ Please send Micromatic literature and case histories.

NAME_____

TITLE_____

COMPANY_____

STREET_____

CITY_____ ZONE____ STATE_____ D

MICROMATIC HONE CORP.
8100 SCHOOLCRAFT AVENUE · DETROIT 38, MICHIGAN

NEW SHOP EQUIPMENT

Air cylinders with built-in directional and exhaust speed control valves, designated VIH Series, are available in 1½, 2, and 3-in. bore sizes in any desired stroke length. Directional control valve actuation can be solenoid, remote pilot pressure, button-bleeder, or combination solenoid-button bleeder. Mountings are completely interchangeable.

Modernair Corp, 400 Preda St, San Leandro, Calif

MORE DATA? Circle 112, inside back cover

Multi-Kut file, added to Red Tang line, is available in flat, half-round, and square shapes and four lengths: 8, 10, 12, and 14 in. New diamond formation chip breaking grooves and varied shapes make it adaptable for all filing applications.

Simonds Saw & Steel Co, Fitchburg, Mass

MORE DATA? Circle 113, inside back cover

Quick-dry enamel, Jet-Dri, permits use of surfaces 15 minutes after painting. Applied by brush, roller dip, or spray, it can be used on concrete, metal and wood equipment, and machinery surfaces.

Consolidated Chemical and Paint Mfg Co, Brooklyn 11, NY

MORE DATA? Circle 114, inside back cover

Conveyor belt has built-in rollers which turn on the connector rod to provide free rolling instead of sliding friction. When used on straight-line conveyors, Roll-A-Load flat wire belts have an extremely high load carrying capacity.

Ashworth Bros, Inc, Winchester, Va

MORE DATA? Circle 115, inside back cover

"Of course your withholding tax has doubled —you keep insisting that you're doing the work of two men."

Air-hardening tool steel, particularly suitable for shops without complete hardening facilities, is pre-colored maroon to eliminate cleaning, coloring, and drying time required for marking ordinary flat stock. Available in nearly 250 sizes from ⅛ by 1 in. in 18-in. lengths, the air-hardening stock combines excellent machineability with wearing qualities midway between high-carbon, high-chromium steels and manganese oil hardening steels.

Brown and Sharp Mfg Co, Industrial Products Div, Providence 1, RI

MORE DATA? Circle 116, inside back cover

Low cost steel collets in round, hexagon and square shapes are now available for users of Jacobs spindle nose chucks. Also available is a steel emergency collet with soft face and pilot hole to permit rapid boring and stepping out when in place in the chuck. Round sizes are priced at $9.75 each.

Hardinge Brothers, Inc, Elmira, NY

MORE DATA? Circle 117, inside back cover

Self-clinching fastener provides a flush mounting on both sides of the sheet in which it is applied, and a **self-clinching captive stud** mounts flush in panels. They can be applied by any standard fastening process. Fasteners are made of No. 303 stainless steel with thread sizes from No. 2-56 to 10-32, for use in sheet materials from 0.061 in. up. Studs are made of steel and No. 305 stainless in thread sizes from No. 4-40 to 5/16-18, in lengths from ¼ to 1½ in.

Penn Engineering and Manufacturing Corp, Doylestown, Penna

MORE DATA? Circle 118, inside back cover

Ejector pins in letter-size diameters for use by metal die-casters have been added to the manufacturers line of regular fractional and 0.005-in. oversize pins. Made in standard 10-in. lengths, the pins are heat-treated die steel, ground, nitrided and honed to a fine finish. With the addition of the letter-size pins, diameters can be supplied in graduated steps from 0.0625 to 0.750 in.

Detroit Mold Engineering Co, 6686 E McNichols Rd, Detroit 12, Mich

MORE DATA? Circle 119, inside back cover

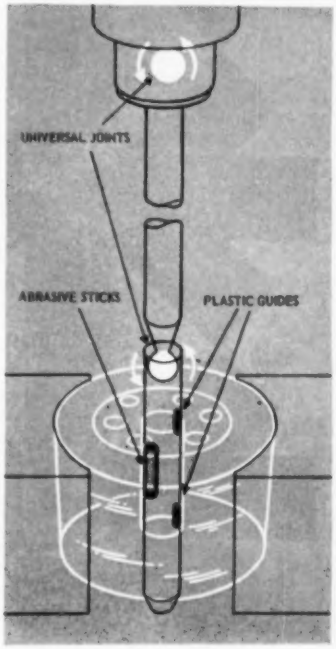
HOW MICROHONING Laminated Rotors Cuts Processing Costs

Emerson Electric squirrel-cage rotors are made of special "electrical grade" steel laminations and each lamination is coated with oxide insulation. In processing the rotor, the O.D. is turned concentric with the shaft hole. Then, in one operation, Microhoning accurately generates finished size and straightness of shaft hole without any change in hole location.

The Micromold tool has two universal joints in the drive shaft which allow the tool body to align itself with the shaft hole. Microhoning of holes is along same axis from which O.D. was turned.

For electrical and mechanical efficiency, assembled motors must have a uniform air-gap between rotor and stator of .006 inch to .011 inch. Because laminated surface is rough and close tolerances must be held, special guided Micromold tools are used. Plastic guides above and below abrasive sticks, control dressing of abrasive and assure generation of round, straight shaft holes.

Before installing Microhoning equipment, two operations were required to finish shaft hole—rejects ran high. Microhoning greatly reduced the amount of dynamic balancing correction required.



The principles and applications of Microhoning are explained in a 30-minute, 16 mm, sound movie, "Progress in Precision" . . . available at your request.

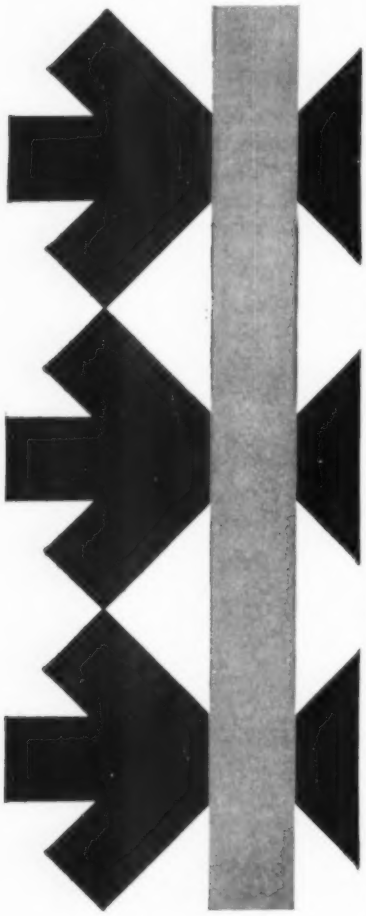
☐ Please send me "Progress in Precision" in time for showing on _____ (date).
☐ Please have a Micromatic Field Engineer call.
☐ Please send Microhoning literature and case histories.

NAME _____
TITLE _____
COMPANY _____
STREET _____
CITY _____ ZONE _____ STATE _____ D

MICROMATIC HONE CORP.
8100 SCHOOLCRAFT AVENUE · DETROIT 38, MICHIGAN

CIRCLE 285 READER SERVICE CARD

V&O
LONG
SLIDE
PRESSES



STILL
the most inherently accurate inclinables you can buy—and so the most logical for mechanized or automated operations.

Emhart Manufacturing Co.
Hudson, New York
V & O Presses and Feeds

EMHART

CIRCLE 286 READER SERVICE CARD

NEW SHOP EQUIPMENT

Precision diaphragm seals can be used at temperatures ranging from –65 to 500 F. Silicones compounded especially for diaphragm applications are combined with popular fabrics such as Dacron and Fiberglas to provide the diaphragm with virtual immunity to a wide variety of chemical and physical environments.

Pacific Moulded Products Co, 905 E 59th St, Los Angeles 1, Calif

MORE DATA? Circle 120, inside back cover

Plug gages are now available in a low cost line of larger sizes—from 0.750 to 1.000-in. dia. Line consists of 251 go and no-go members in increments of 0.001 in., with a guaranteed tolerance of ±0.00007. Price is $2.75 per member in lot of four or more.

Dundick Tool Works, Inc, 3410 W 31st St, Chicago 23, Ill

MORE DATA? Circle 121, inside back cover

Synthetic colloidal graphite blended with a carrier is said to offer exceptional lubricating properties for general industrial use, especially in high temperature applications such as conveyors and heat-treating furnaces.

King Graphite Products, Inc, 21949 S Telegraph Rd, Trenton, Mich

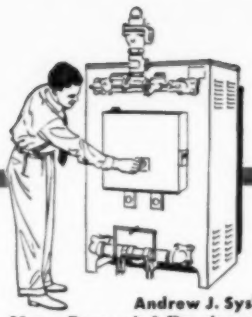
MORE DATA? Circle 122, inside back cover

Aluminum welding wire, 4043, an all-purpose filler material for gas and electric fusion welding, has a tensile strength of 30,000 psi and a melting point of 1055 F. Its principle alloying element is 5% silicon. It will effectively join such wrought alloys as 5052, 6053, and 6061, and can be used on many cast aluminum alloys.

Dalweld Co, Inc, 13 Bertel Ave, Mt Vernon, NY

MORE DATA? Circle 123, inside back cover

"I like a man who can make his own decisions."



Andrew J. Syska,
Hayes Research & Development Engineer Reports . . .

KNOW-HOW IS VITAL IN GAS AND LIQUID DRYING

When we developed the Molecu-Dryer®—a unit specially designed to take advantage of the remarkable drying, sweetening, and purifying capabilities of Linde Company's Molecular Sieves—our chief interest was in drying protective atmospheres (hydrogen, dissociated ammonia, etc.) for metallurgical work—to dewpoints well below –100°F. A natural outgrowth of the Molecu-Dryer was the *Nitro-Gen*®—an automatic cycling generator which produces low cost, high purity nitrogen for blanketing, purging, protecting. Our engineering people have also explored whole new worlds of gas, liquid, and atmosphere drying and separating problems.

NEW DRYING NEEDS APPEAR DAILY

In manufacturing transistors, for example, the Molecu-Dryer has been able to effect big economies by supplying moisture-free air in place of tank nitrogen to protect transistor assembling and sealing operations. Other current projects: instrument air drying, gaseous CO_2 drying, gas separating . . . also drying and separating of liquid or gaseous hydrocarbons.

EQUIPMENT DESIGN IS DYNAMIC!

Each new area of work has necessitated engineered application of standard or special Molecu-Dryer models, to provide optimum adsorption efficiency, top capacity at minimum equipment cost, job-coordinated cycle times, and fast desorption and cooling.

For a comprehensive picture of the Molecu-Dryer, write for Bulletin 5703.

*Hayes TM

C. I. HAYES, INC.
837 Wellington Avenue • Cranston 10, R. I.
Established 1905

It pays to see HAYES for metallurgical guidance, laboratory facilities, furnaces, atmosphere generators, gas/fluid dryers.

CIRCLE 287 READER SERVICE CARD

CIRCLE 288 READER SERVICE CARD ▶

Everybody knows that

National Tool Company

makes special hobs—

But did you know

we make special carbide

tipped surface broaches...

and more special cutting tools of all kinds

than any other tool manufacturer?

For more than half a century National Tool Company has supplied high quality precision cutting tools to the metal working industry. When your job requires special cutting tools call your National Tool representative. His assistance is yours for the asking whether you're interested in one *special* tool or a complete tooling program.

NATIONAL Tools CLEVELAND

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TOOL CO.

Cleveland 2, Ohio

Representatives in major industrial centers

New FREE Catalog

To National Tool Co., 11200 Madison Ave., Cleveland, Ohio

Please send NEW 92 page catalog showing National Tool Company's complete line of *special* tools for the metal-working industry.

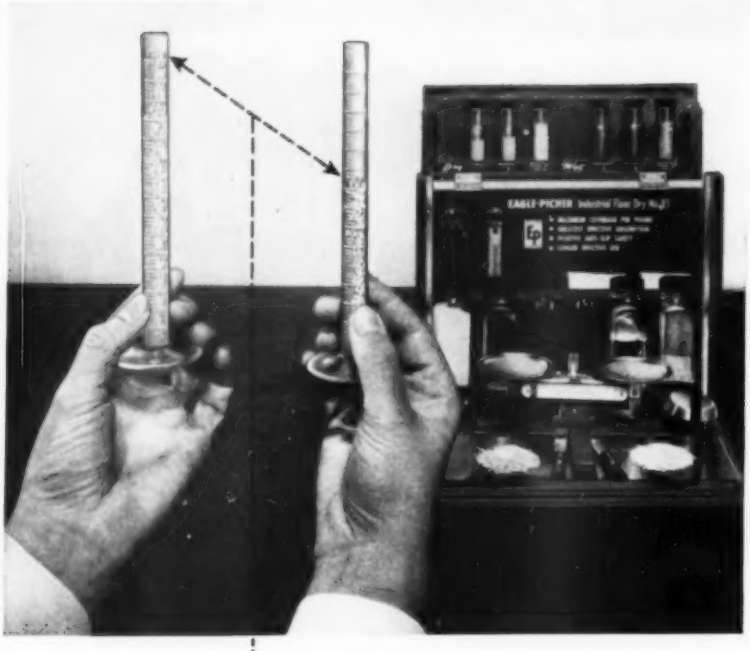
Name_____

Position_____

Company_____

Address_____

City_____ Zone_____ State_____



There's a BIG difference in floor absorbents

TEST IT Yourself!

IN YOUR OWN OFFICE, make this simple 15-minute test. Compare Eagle-Picher Industrial Floor-Dry to any other floor absorbent.

HERE'S WHAT YOU'LL PROVE TO YOURSELF about safe, skid-proof Eagle-Picher Floor-Dry: It's extremely insoluble, absorbs more oil and water. It goes further, provides much greater coverage. It reflects more light, brightens the work area. It's non-combustible, has no chemical reaction. It lasts longer, saves you money!

Since 1843 EAGLE EP PICHER

WRITE TODAY. Our Eagle-Picher representative will bring the portable laboratory to your office where you may make this test yourself. The Eagle-Picher Company, Cincinnati 1, Ohio.

NEW SHOP EQUIPMENT

Powered caster unit, Electromite M2, designed to handle loads in the 1000 to 1600-lb weight class, can be installed on existing stock trucks, hydraulic lifters, hand trucks, and other loading equipment. Speeds, either forward or reverse, may be obtained from 0 to 10 mph. Available in 8, 10, and 12-in. sizes.

Swartzbaugh Mfg Co, Murfreesboro, Tenn

MORE DATA? Circle 124, inside back cover

Bartalloy-P, a bright gold plating solution, is said to produce a deposit equivalent to 18k gold. Other advantages offered are hardness range of 300 to 450 VHN, superior color, and elimination of need for the Hamilton Flash when used for decorative purposes.

Bart Mfg Corp, 227 Main St, Belleville, NJ

MORE DATA? Circle 125, inside back cover

Brazing alloy, high-nickel base Nicrobraz 160 for high-temp service, is similar to Standard Nicrobraz AMS 4775 but has lower initial hardness. It produces joints with lower hardness that are more easily machined. It is available as powder, impregnated plastic wire, powder-flux paste, or prefabricated rings.

Wall Colmonoy Corp, Stainless Processing Div, 19345 John R St, Detroit 3, Mich

MORE DATA? Circle 126, inside back cover

Basket for use in heat treating operations provides complete surface exposure for up to 500 machine knives. Designed to be used with an automatically controlled electric furnace, stainless steel unit will hold loads of 5000 lbs. It measures 54 in. in dia, is 48 in. deep.

Wiretex Mfg Co, 40 Mason St, Bridgeport, Conn

MORE DATA? Circle 127, inside back cover

Double hydraulic valve is available in 3-way and 4-way combinations and in sizes from 2 gpm to 40 gpm, with detented or spring return handles. Cem-Lap seals mating with optically flat rotor surfaces assure positive sealing at 2500 psi pressure for oil and 2000 psi for water and gas.

Clark Engineering & Manufacturing Co, 1820 Layard Ave, Racine, Wis

MORE DATA? Circle 128, inside back cover

"TOUGH NUTS?...We Put Ours on NATIONAL Cold Nut Formers!"

These Unusual Nuts Are Being Made from Various Materials (Including High-Carbon) on National Cold Nut Formers.

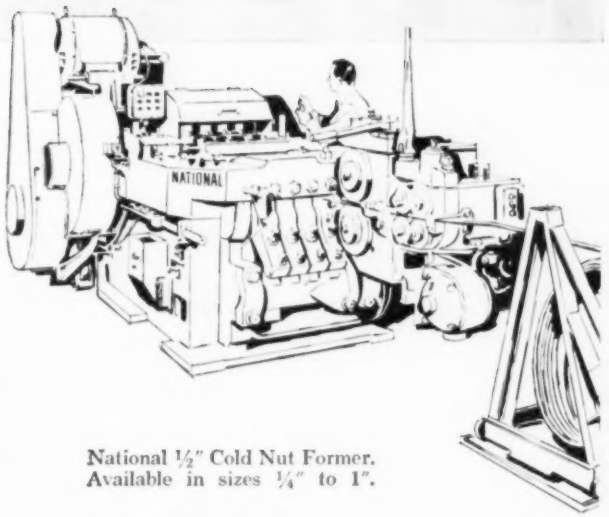
The slogan, "We Put Our Tough Ones on Nationals," is not one we dreamed up.

It sprang up in the trade, among the highly-skilled and well-equipped Nut manufacturers who have been meeting competently your "impossible" demands and your normal needs.

Have you looked into the design variations and high quality attainable these days by users of National Cold Nut Formers? If you make Nuts, or other cold-formed parts (or parts which should be cold-formed) have you considered widening your range and type of work? By offering the most modern, productive and profitable Cold Nut Formers available, we can help you meet quickly the growing demands of metalworking.

Tool design? Our working development engineers — contributing daily to the science of Metal Flow — are at your service.

Let us work with you.



National ½" Cold Nut Former. Available in sizes ¼" to 1".

Founded 1874 — DESIGNERS and BUILDERS of MODERN FORGING MACHINES • MAXIPRESSES • REDUCEROLLS • COLD HEADERS BOLTMAKERS • NUT FORMERS • TAPPERS • NAILMAKERS CO-PIONEERS WITH INDUSTRY OF ADVANCED METALWORKING PRODUCTION METHODS

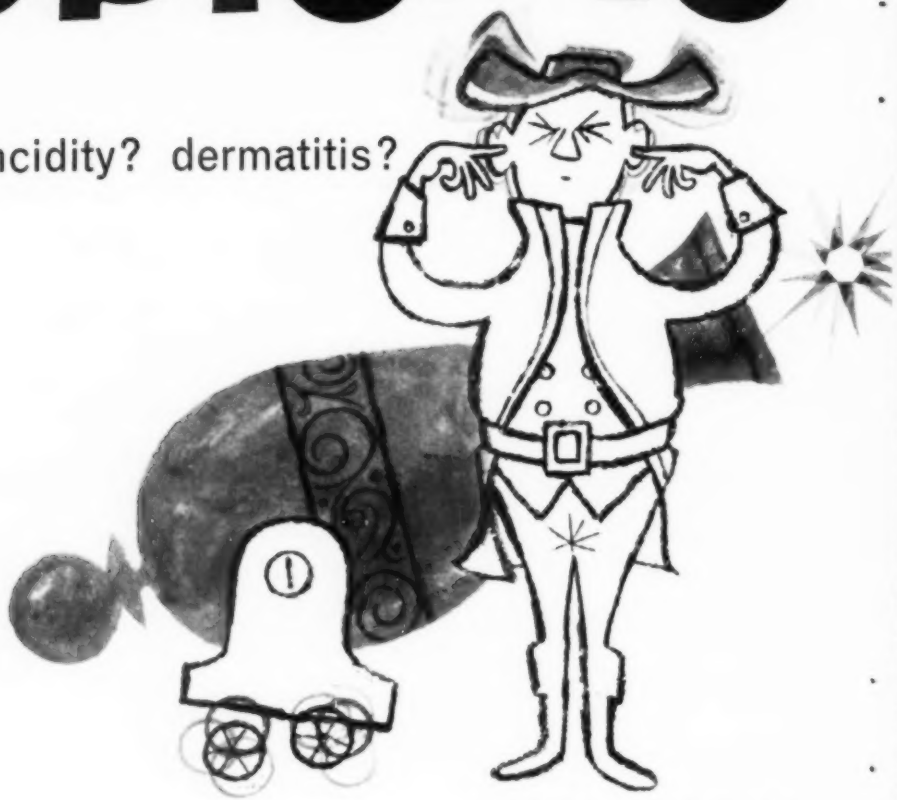
NATIONAL MACHINERY CO.

TIFFIN, OHIO, U. S. A.

HARTFORD DETROIT CHICAGO

coolant problems

rust? rancidity? dermatitis?



Cold Stream stops rust resists rancidity reduces causes of dermatitis These problems start when your coolant gets dirty. Cold Stream stays clean week after week—even on cast iron. Cold Stream gives longest tool life. Finest finishes. Highest speeds and feeds. Best dimensional control. Cold Stream gives you everything you ever expected in a coolant!

JOHNSON'S

cold stream

Stays clean week after week and gives you all the performance you pay for.

JOHNSON'S WAX

For information, see your local Johnson industrial distributor.

"Cold Stream" and "Johnson's" are trademarks of S. C. Johnson & Son, Inc., Racine, Wisconsin

(PATENT APPLIED FOR)

NEW MANHATTAN SAFETY BACK FLARED CUP

Not simply a new safety "feature" . . . not merely a design "improvement." Here's a *totally new concept* of flared cup wheel design *and* construction . . . developed by Manhattan engineers to give the greatest safety and performance advantages possible for flared cup wheel users. Manhattan's revolutionary SAFETY BACK Flared Cup puts portable wheel *safety* where it counts the most—in *original* strength and breakage resistance!

SAFETY BACK, far surpasses such safety features as anchor bushings, safety rings, special hub mountings, or ordinary revolving cup guards. With SAFETY BACK, steel covers the *entire* back of the flared cup . . . extends down the side to offer a degree of reinforcement and breakage resistance never before possible!

NO OTHER WHEEL—AT ANY PRICE—OFFERS THESE EXCLUSIVE FEATURES

- **Greatest Initial Strength**
- **Highest Safety Factor**
- **Easy Mounting—Easy Operation**
- **Improved Mounting Base**
- **One Piece Assembly**
- **Requires No Adjustment**

Only SAFETY BACK gives you these features—*plus* Manhattan's custom-engineered abrasive bond for *faster* removal of *more* metal on your particular job—at no additional cost! For "More Use per Dollar" in portable grinding operations, you can't get a faster cutting, longer lasting—*safer* wheel than MANHATTAN.

Let a Manhattan abrasive wheel engineer show you the advantages of SAFETY BACK Flared Cups, and other types of Manhattan high speed, heavy duty abrasive wheels. Write for Bulletin 7157.

RM-783

WRITE TO THE ABRASIVE WHEEL DEPARTMENT

MANHATTAN RUBBER DIVISION—PASSAIC, NEW JERSEY

RAYBESTOS-MANHATTAN, INC.

Belts • Hose • Roll Covering • Tank Linings • Industrial Rubber Specialties • Abrasive and Diamond Wheels • Brake Blocks and Linings • Clutch Facings • Asbestos Textiles • Mechanical Packings • Engineered Plastics • Sintered Metal Products • Industrial Adhesives • Laundry Pads and Covers • Bowling Balls

Aluminum-epoxy resin solder named Poly Epoxyn is a plastic solder for repairing of dents and holes in cold-formed metal. It can be applied, hardened, and made ready for painting in a few minutes. Epoxy compound, based on Bakelite resins (manufactured by Union Carbide Plastics Co, division of UCC), is reported to have excellent adhesion and high-impact strength.

Co-Polymer Chemicals Inc, Livonia, Mich

MORE DATA? Circle 129, inside back cover

Long-travel dial indicator, Model E81U, is specially designed to measure slide travel, cam throw, etc. It has a total range of 3 in. and is graduated in 0.001-in. increments. To enable quick reading anywhere in the total span of 30 revolutions, this indicator is equipped with two counter dials. One is divided into ten segments of 0.100 in. each to count individual revolutions; the other is divided in inches.

Federal Products Corp, 1144 Eddy St, Providence, RI

MORE DATA? Circle 130, inside back cover

Non-magnetic foils, called Sub-Micro Platinum-Iridium Gap Foils, ranging from 40 to 250-millionths of an inch thin, developed for special requirements in the electrical, electronics, and nuclear industries, are reported to be as hard as spring-hard phosphor bronze and completely corrosion-proof.

American Silver Co, 36-07 Prince St, Flushing 54, NY

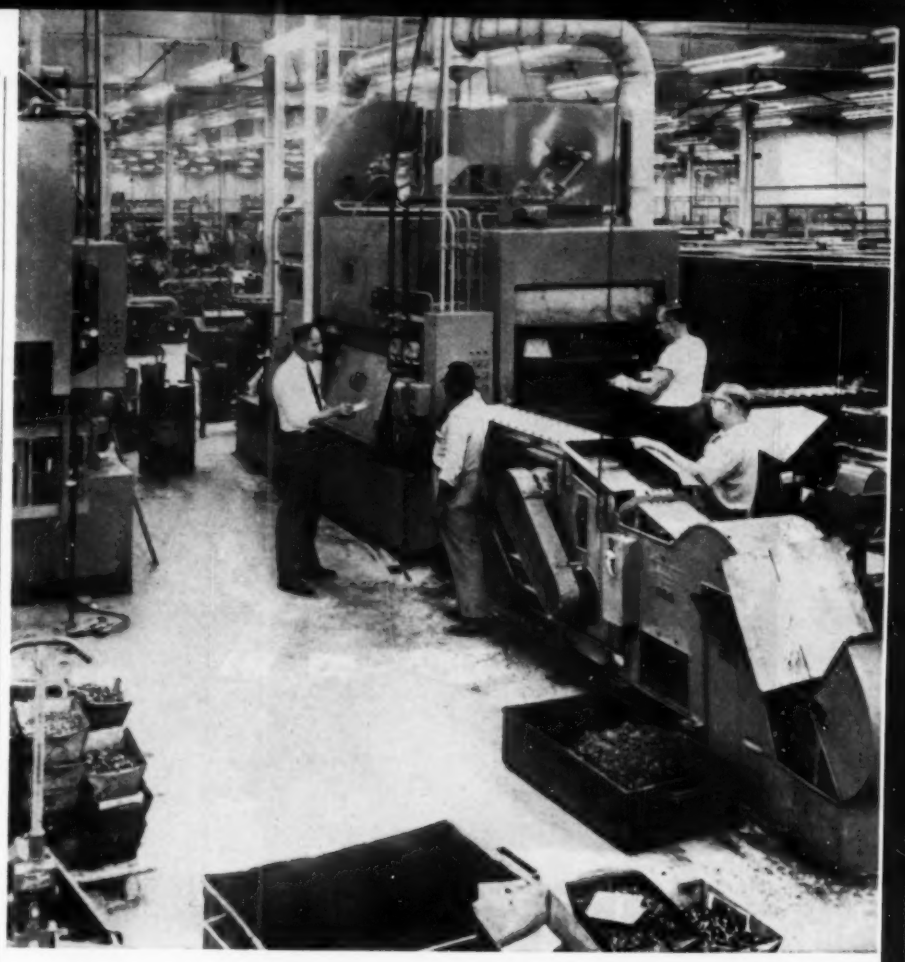
MORE DATA? Circle 131, inside back cover

Gold plating process results in deposits which show hardness and wear resistance that are five to ten times as hard as gold deposits from a cyanide bath and two to three times as hard as deposits from bright cyanide gold solution. According to the manufacturer, deposits from the Auro Glo Gold Bath have superior welding and soldering characteristics, do not bleed out, and do not require extreme leaching.

Lea-Ronal Inc, 139-20 109th Ave, Jamaica 35, NY

MORE DATA? Circle 132, inside back cover

CIRCLE 294 READER SERVICE CARD ►



Better Cleaning means Better Socket Screws for You

from ALLEN

These new industrial washing machines wash every Allen product — after each processing operation, and before heat treating — to remove all abrasives and contaminants. After washing, a vibrating de-chipper (shown in the foreground) removes metal particles that may adhere to products in process.

These are among the great many special features in Allen's new plant that assure you of constantly higher quality in socket screws. More than ever, you'll find that ALLEN is the "Buy-Word" for socket screws, as well as keys, dowel pins, and pipe plugs.

The scientific design of the cup diameter on ALLEN-POINT Set Screws gives greatly increased resistance to *withdrawal* torque. You can count on Allenpoints to stay tighter longer, under heavy strain and vibrations. This dependable performance is yours to use at no premium in cost. Available in a full range of standard sizes from No. 0 thru 1". For samples and more information, ask your Industrial Distributor, or write direct to The Allen Manufacturing Company, Hartford 1, Connecticut.

ALLEN HEX-SOCKET SCREWS HEAD

Specify

BIJUR

AUTOMATIC LUBRICATORS

For DESIGN, SERVICE AND RESEARCH are part of every Bijur System

Consider Design — All Bijur pumps are designed to be an integral part of your equipment not a cumbersome attachment. Compact modern designs permit easy adaptation, enabling operation of the pump by means of gear, belt or chain drive or independently operated by electrical or hydraulic set-ups.

How you benefit — Custom-engineered Bijur automatic lubricating systems save production time and repair bills. Down-time and fire risks are sharply reduced. Costly hand oiling is eliminated and every bearing gets the right amount of oil when needed – there's no chance of under oiling or over oiling.

Day-in, day-out Bijur Systems are proving their value to designers, plant engineers and production men on the equipment they design, use, or manufacture. Write today for all the facts about Bijur automatic lubricating systems!

BIJUR AUTOMATIC LUBRICATORS—STANDARD EQUIPMENT IN MANY INDUSTRIES
Machine Tools • Business Machines • Printing Machinery • Textile Machinery • Food Product Machines • Bottling Machines • Packaging Machines • Sheet Metal Machines • Plastic Fabricating Machinery • Glass Products Machinery • Wood-Working Machinery • Industrial Sewing Machines • Special Process Equipment

BIJUR
LUBRICATING CORPORATION
Rochelle Park, New Jersey

Pioneers in Automatic Lubrication

4141

NEW SHOP EQUIPMENT

Hysol Epoxy Patch Kit 6C has been developed for easy, permanent repairs of tools, castings, and heavy machinery. Material is said to be strong enough to assure perfect repair for both ferrous and non-ferrous metal castings, plastics, or fittings on vacuum vessels. Kit contains two tubes, one of base resin, the other of hardener. Complete hardening will occur in one to two hours, but can be accelerated by application of low heat.

Houghton Laboratories Inc, Olean, NY

MORE DATA? Circle 133, inside back cover

Overload protector for fractional horsepower motors, known as MP-1620, automatically shuts off current when motor temperature or current rises dangerously, and restores motor operation when the temperature or current is dropped.

Mechanical Products, Inc, Jackson, Mich

MORE DATA? Circle 134, inside back cover

Sliding Shelf shelving is available in eight standard sections; extra parts can be added to meet requirements. Sections are 37⅞ in. wide, 12-5/16 in. deep, 84 in. high. Sliding shelves are adjustable on 1½ in. centers, slip easily into slots in uprights, automatically lock in place.

Lyon Metal Products, Inc, 2 Clark St, Aurora, Ill

MORE DATA? Circle 135, inside back cover

". . . check those valves daily you say, Jason?"

BATH *Tap'n Gage* TIMES

A series of technical discussions that will be helpful in getting better results from tapping and gaging operations

Vol. 1 No. 5

Subject: Tap and Screw Thread Nomenclature:

ALLOWANCE: The minimum clearance or maximum interference which is intended between mating parts.

ANGLE OF THREAD: The angle included between the flanks of a thread measured in an axial plane.

BACK TAPER: A slight taper on threaded portion of the tap making the pitch diameter near the shank smaller than that at the chamfer.

BASIC: The theoretical or nominal standard size from which all variations are made.

CHAMFER: The tapered and relieved cutting teeth at the front end of the threaded section. Common types of chamfer are taper, plug and bottoming.

CREST: The top surface joining the two sides or flanks of a thread.

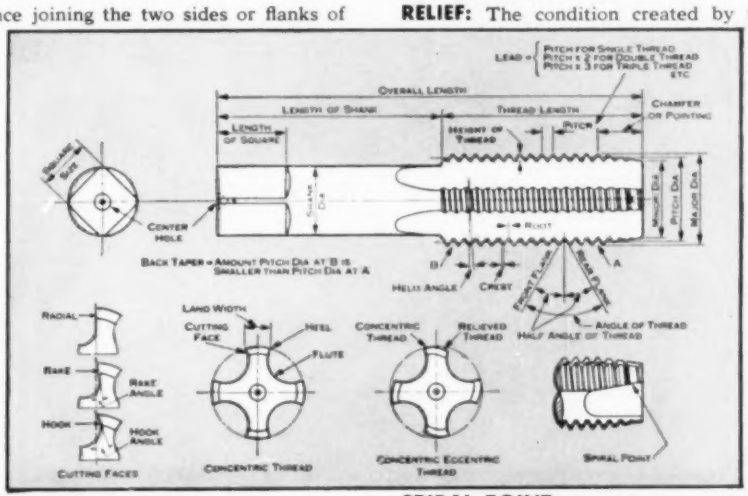
CUTTING FACE: The leading side of the land.

FLUTE: The longitudinal channels formed on a tap to create cutting edges on the thread profile.

HEEL: The following side of the land.

HEIGHT OF THREAD: In profile, distance between crest and bottom section of thread measured normal to the axis.

HOOK FACE: A concave cutting face of the land. This may be varied for different materials and conditions.



INTERRUPTED THREAD: Alternate teeth are removed in the thread helix on a tap having an odd number of flutes.

LAND: One of the threaded sections between the flutes of a tap.

LEAD OF THREAD: The distance a screw thread advances axially in one turn.

MAJOR DIAMETER: The largest diameter of the screw or nut on a straight screw thread.

MINOR DIAMETER: The smallest diameter of the screw or nut on a straight screw thread.

NECK: The reduced diameter, on some taps, between the threaded portion and the shank.

PITCH: The distance from a point on one thread to a corresponding point on the next thread, measured parallel to the axis.

PITCH DIAMETER: On a straight screw thread, the diameter of an imaginary cylinder where the width of the thread and the width of the space between threads is equal.

POINT DIAMETER: The diameter at the leading end of the chamfered portion.

RADIAL: The straight face of a land, the plane of which passes through the axis of the tap.

RAKE: The angle of the cutting face of the land in relation to an axial plane intersecting the cutting face at the major diameter.

RELIEF: The condition created by removing metal from behind the cutting edge to produce clearance and reduce friction. Usually applied to larger taps where drag is a problem.

ROOT: The bottom surface joining the flanks of two adjacent threads.

SIDE OR FLANK OF THREAD: The surface of the thread which connects the crest with the root.

SHANK: The portion of the tap by which it is held and driven.

SPIRAL POINT: An oblique cutting edge ground into the lands to provide a shear cutting action on the first few threads.

SQUARE: The squared end of the tap shank.

THREAD: The helical formed tooth of the tap which produces the thread in a tapped hole.

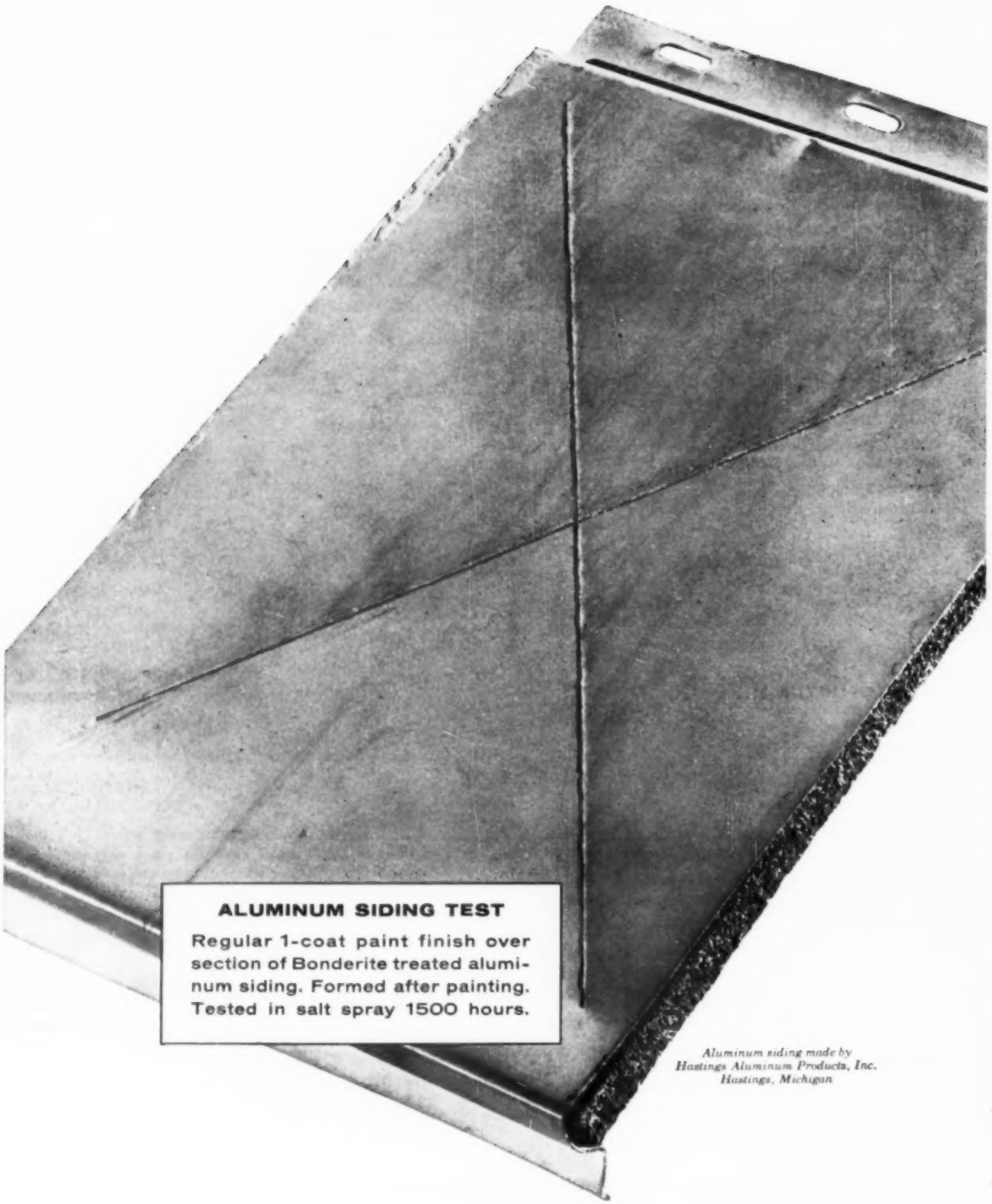
THREAD LEAD ANGLE: The angle made by the helix of the thread at the pitch diameter, with a plane perpendicular to the axis.

THREADS PER INCH: The number of threads in one inch of length.

THREAD: SINGLE: A thread in which lead is equal to pitch. DOUBLE: A thread in which lead is equal to twice the pitch. TRIPLE: A thread in which lead is equal to triple the pitch.

•Cylindrical and Thread Gages • Ground Thread Taps • Internal Micrometers John BATH & Co., Inc.
22 Mann Street, Worcester, Mass.

BONDERITE



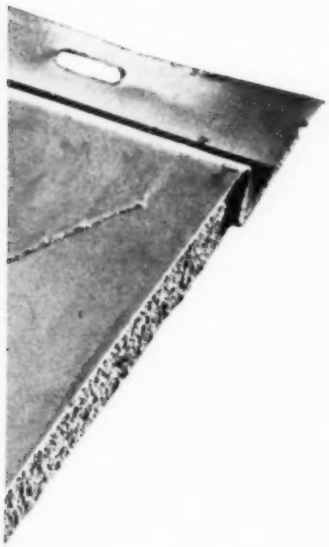
ALUMINUM SIDING TEST

Regular 1-coat paint finish over section of Bonderite treated aluminum siding. Formed after painting. Tested in salt spray 1500 hours.

Aluminum siding made by Hastings Aluminum Products, Inc. Hastings, Michigan

for ALUMINUM

Better paint adhesion...better corrosion control



In two hundred plants—many of them the leaders in their particular fields of aluminum fabrication—Bonderite for aluminum is being used today!

Bonderite makes it possible to take aluminum in the coil, run it through a continuous line in which the strip is cleaned, Bonderized, roll-coat painted, dried—and then recoiled.

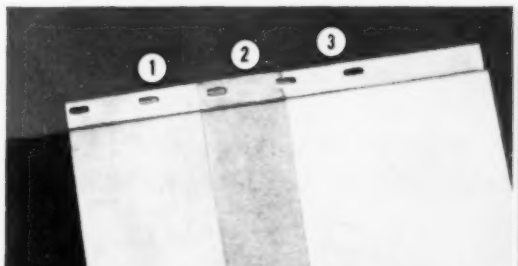
Because Bonderite gives paint such a secure foothold, it will stand severe forming operations (see photo below). With the Bonderite corrosion barrier at work, durability of the paint finish is almost indefinitely prolonged.

Bonderite meets and exceeds the requirements of Government Specification MIL-C-5541. Bare corrosion resistance is outstanding.

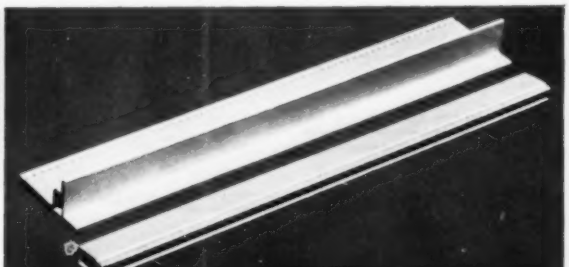
There's more than one type of Bonderite for aluminum. Besides the paint base, there's a Bonderite that creates a pleasant green coating, for use on architectural products. There's a Bonderite which protects without changing the characteristic color of the aluminum. Another Bonderite coats aluminum, steel and zinc—just the thing for mixed production.

There is a Bonderite, in fact, for every form of aluminum production, and for practically every alloy.

The big news in surface treatment for aluminum today is Bonderite! Let a Parker man tell you all about it!



Here's the 1-2-3 for durability of painted aluminum. Section of siding shows bare aluminum, (1); Bonderite treated, (2); and roll-coated paint, (3).



These aluminum window and screen frame sections were Bonderized and painted in the strip and formed after painting. There isn't a break in the finish anywhere!

Since 1914—leader in the field

PARKER RUST PROOF COMPANY
2196 E. Milwaukee, Detroit 11, Michigan
Tel: TRinity 5-3377

BONDERITE corrosion resistant paint base	BONDERITE and BONDERLUBE aids in cold forming of metals	PARCO COMPOUND rust resistant	PARCO LUBRITE wear resistant for friction surfaces	TROPICAL heavy duty maintenance paints since 1883

*Bonderite, Bonderlube, Parco, Parco Lubrite—Reg. U.S. Pat. Off.

ENGINEERS . . PRODUCTION MEN . .

Free Bulletin on Surface Measurement

gives all the important material of ASA Standard B46.1-1955 on surface roughness, waviness and lay, plus helpful supplementary material. It is arranged for easy reading and convenient reference, and includes these sections:

- Basic definitions — with profile records of a typical surface.
- How to designate and measure the characteristics of roughness, waviness and lay.
- Arithmetical and r.m.s. average roughness height.
- How the Profilometer® measures average roughness height.
- Instrument characteristics for roughness measurement — as specified by the standard, and as provided by the Profilometer.

It's timely — authoritative — comprehensive. Eight pages, illustrated. *Write for BULLETIN LT18.*

Profilometer is a registered trade-mark.

MICROMETRICAL MANUFACTURING COMPANY
345 S. MAIN ST. ANN ARBOR 1, MICHIGAN

FIELD REPORT...

Potter & Johnston Moves to Conn

All operations of Potter & Johnston Co, subsidiary of Pratt & Whitney Co, have been moved from Pawtucket, RI, to the plant of the parent company in West Hartford, Conn. Consolidation of the engineering and manufacturing of both machine tool companies will give added facilities and more efficient manufacturing techniques to the P&J line. New address is Potter & Johnston Co, Charter Oak Blvd, West Hartford 1, Conn.

$13 Million Ford Trucks

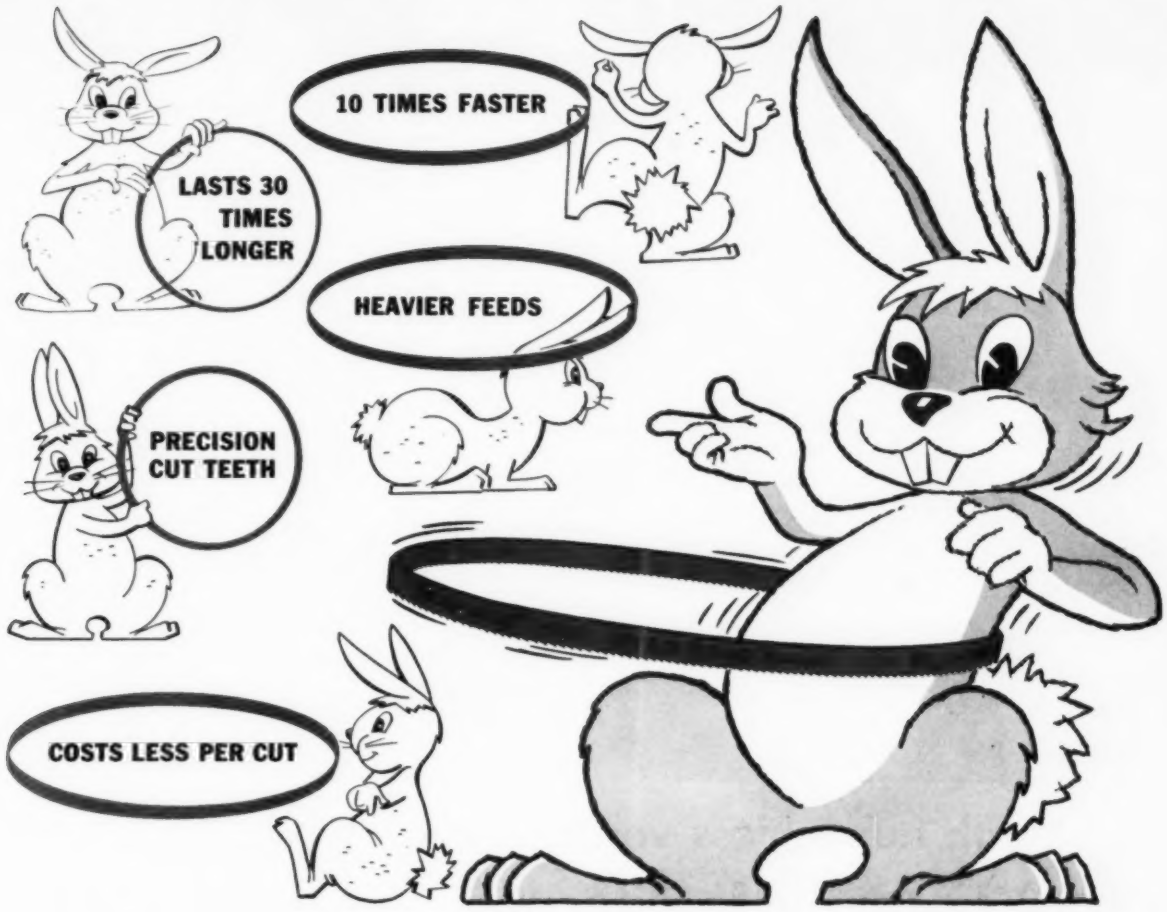
Government has ordered more than $13 million worth of Ford trucks to be built at assembly plants over the nation during the next seven months. Contracts call for delivery of pickup trucks and 1½-ton stake platform units for use by the military in this country and overseas. About half of the vehicles will be assembled at the division's Norfolk, Va, assembly plant; other plants involved are Atlanta, Chicago, Dallas, Kansas City, Louisville, Mahwah, NJ; Lorain, Ohio; San Jose, Calif; St Paul.

$5 Million Order to Sylvania

Signal Corps contract has gone to the data systems facility of Sylvania Electric Products, Needham, Mass, for development and production of three MOBI-DIC (mobile digital) computers.

(Continued on p202)

"Doesn't Personnel know what 4-in. automatics are?"



MULTIPLY PRODUCTION

with Blu-Mol® high speed steel band saws

Last 20% longer than other high speed steel bands

After years of development, these new Blu-Mol high speed bands have been exhaustively tested in the laboratory and proved on job after job. For example, on one production run cutting M-2 High Speed Steel, 200 bands were used. Operating at a rate of 2 square inches/minute with a blade speed of 160 feet/minute, the average life of each band was *over 6000 square inches!*

These Blu-Mol high speed bands cost less per cut than any other metal cutting blade. 10 times faster or 30 times longer lasting than carbon steel bands. *High temperature hardness* keeps cutting edge hard even under most punishing conditions. Designed especially for production cut-off work, these high speed blades are the best bands made!

World's broadest, most highly developed line of metal cutting saws

MILLERS FALLS TOOLS
SINCE 1868 ®

MILLERS FALLS COMPANY, Dept. AM-17, Greenfield, Massachusetts

"Now, with our Schiess vertical turret lathe

one 8-hour shift does the work of three!"

says Arnold R. Kline, plant manager, O.K. Rubber, Inc., Littleton, Colo.

Schiess 13EK-150 Vertical Turret Lathe turning a 33 in. "Nu-Matic" tire mold sidewall plate, made of #12 cast aluminum.

"Production on sidewall tire molds jumped 300%. Material spoilage was reduced 50 to 60%. Per unit cost dropped 60%. And we have a better machined end product!" That's the way Arnold Kline wraps up the production story at O.K. Rubber, since he installed this Schiess machine.

He continues: "We've got the Schiess mill doing everything from boring 1¼ in. holes to turning plates 56 in. in diameter. We thought we'd need a custom-made mill to do our kind of work. We don't think that way any more."

"And frankly, we were amazed at the price—30 to 40% lower than we expected!"

No costly training time was needed. Skilled machinists were checked out on the mill in just a few hours. Operators particularly liked the horizontal head, the rapid traverse lever, the cross-rail mechanical controls. All contributing to greater accuracy . . . better finish . . . less machining time.

Get to know this and other products of Europe's largest builder of heavy machine tools. Parts and service are as close as Pittsburgh. An American Schiess engineer will be happy to help you select the proper tool for your production needs. Write today.

SCHIESS

AMERICAN SCHIESS CORPORATION • 1232 Penn Avenue, Pittsburgh 22, Pa.

CIRCLE 301 READER SERVICE CARD

this 480 ton giant has 5 heads

combined planer and milling machine

No need to risk the inaccuracies that come from moving a workpiece weighing up to 100 tons from machine to machine for different operations. One set-up is all you need with this Waldrich Siegen machine. And just think of the tremendous savings in set-up time and costs.

Three milling heads take care of milling, boring and thread cutting operations; another head does planing and grinding; and there's a planer side head, too.

The Waldrich patented tool retracting mechanism in the planer head raises tool in a straight vertical plane after unclamping, repositions tool automatically, then reclamps. Cross rail is clamped hydraulically in exact horizontal position, located by separate electric drive. Built-in optics confirm accurate location.

Rigid, you bet—from top to bottom! Waldrich construction features a base plate crossing under machine and tying columns and bed into one ruggedly rigid unit. And there's a total of 900 h.p. working for you.

Write for all the specs on this mammoth producer. And ask a Waldrich engineer to discuss them in detail—in terms of your production needs.

WALDRICH SIEGEN

american waldrich mfg. corp.

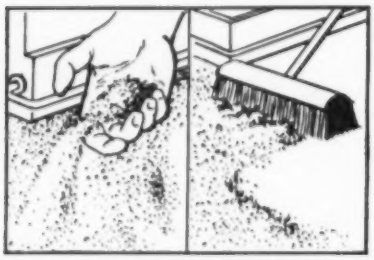
1232 PENN AVENUE, PITTSBURGH 22, PENNSYLVANIA

CIRCLE 302 READER SERVICE CARD

Have you sent for your FREE SAMPLE of FLORCO?

It is the most effective, practical and economical adsorbent for industrial and commercial use.

Approved by Armed Forces specifications and Underwriters Laboratories, Inc.



1.—Sprinkle Florco on 2.—Sweep it up

Floor is **Safe** and **Clean**

TRY FLORCO FREE

You'll be pleased with results and service from our nearest warehouse. Mail coupon below today

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P. O. Box 989, Dept. V
Tallahassee, Florida

O.K. I'll try Florco on my floor.
Send me, without cost or obligation, my free sample.

Name _____ Title _____

Address _____

City _____ Zone ____ State _____

Type of Business _____

Field Report . . .

Boyar-Schultz Diversifies

Boyar-Schultz Corp, manufacturer of special machinery, machine tools, and screw machine tools has acquired for production and distribution the Cookie-Matic automatic cookie machine formerly manufactured and sold by the Middleby-Marshall Oven Co of Chicago. Machine is now being made by B-S in its Broadview, Ill, plant and will be distributed through a subsidiary known as the Cookie-Matic Bakery Equipment Division of Boyar-Schultz.

Lab to Study Effects of Radiation On Various Materials and Fuels

Laboratory to be built during the year at the Connecticut Aircraft Nuclear Engine Laboratory at Middletown, Conn, is expected to be in operation in early 1960. New CANEL facility will be built with Air Force funds and staffed by a Pratt & Whitney Aircraft technical team which has been performing work similar to that planned in the new lab since 1955 at Livermore, Calif, where the University of Calif operates an Atomic Energy Commission facility.

Included in the new 21,000 sq-ft structure will be seven special cells in which experiments with materials which have been exposed to radiation will be conducted by remote control. Building will also house chemistry and metallurgy labs, a machine shop, engineering and office areas, and special equipment and facilities.

Sun Oil Splurging

Sun Oil Co plans to spend $125 million on capital improvements, expansion, and exploration this year, third highest total in its history. Expenditures include $90 million for modernization and expansion and $35 million for drilling of oil and gas wells on both the North and South American continents.

Permattach Diamond Tool Co Acquired by Hitchiner Mfg Co

Hitchiner, producer of precision investment castings, has taken over assets of Permattach, will operate it as a subsidiary. Permattach was originally started to make diamond dressing tools, drills, and phonograph needles using a new process to attach diamonds to holders. They've recently developed a method of orienting diamonds in shanks so as to increase tool life and reduce maintenance.

Dodge Manufacturing Corp Buys Into Australian Firm

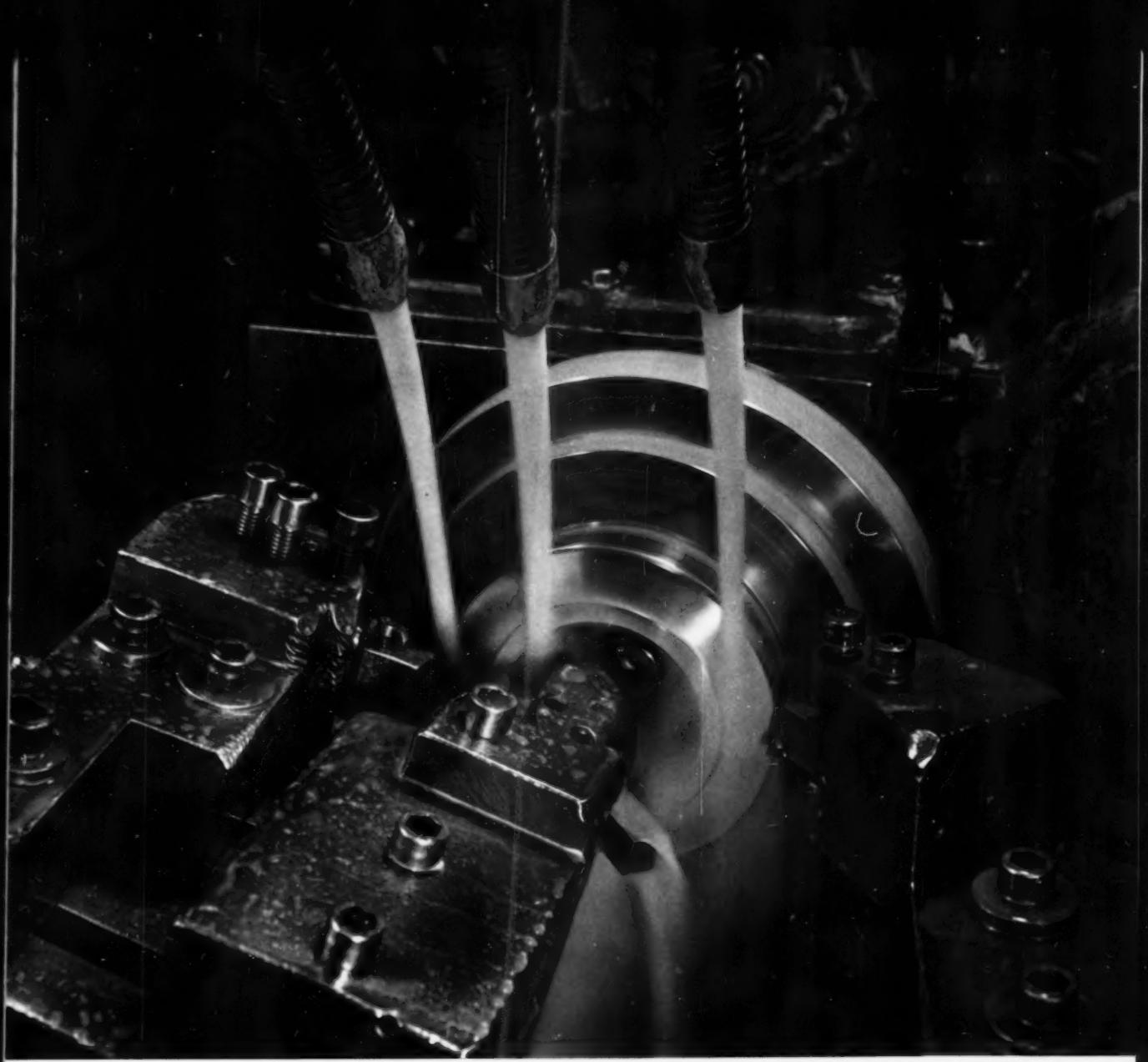
Dodge, Mishawaka, Ind, has acquired a 40% interest in a new company, Fenner Dodge (Australia) Pty Ltd, to manufacture V-belts and mechanical power transmission products in Australia. Manufacturing will begin this month in a 20,000 sq-ft factory on an 11-acre plant site on the outskirts of Sydney. First products to be turned out will be Taper-Lock V-belt sheaves, with other Taper-Lock products such as couplings and sprockets to follow. Torque-Arm speed reduction units also will be made there later. Australian company is jointly owned with J H Fenner & Co, Ltd, of Hull, England, which manufactures Dodge-patented products under license.

Big Truck Order to Harvester

Army has ordered 2928 five-ton trucks from International Harvester Co at a total cost of $29.7 million. Tactical vehicles will be six wheelers with six-wheel drive. They'll be turned out at the Fort Wayne, Ind, plant.

(Continued on p205)

"He's the guy that's always saying . . . how else are they going to know you're around if you don't make a mistake once in a while . . .



Improved *Lusol* the coolest coolant of them all

Improved Lusol, an oil-free, transparent, water soluble solution, has the highest heat-removing capacity of all coolants, regardless of type.

This means cooler work pieces and cooler tools; makes possible increased speeds, increased feeds, increased accuracy, better finish and *greatly increased tool life.* Summing it up, Lusol means better production at lower cost.

But this is not all—Lusol, an oil-free solution, means cleaner machines and a cleaner plant. It eliminates smell and smoke. It is bland to the hands and cuts out dermatitis. Operators certainly appreciate it. As one said, "I feel as if I were in a new plant—no smell, no smoke, no slippery oily floors—and my wife likes me better when I come home."

Proved for years in hundreds of plants from coast to coast, Lusol is worth investigating NOW. Send for our 16-page illustrated catalog today, describing Lusol and the other Anderson metalworking products.

ANDERSON
OIL and CHEMICAL COMPANY, INC.
BOX 305, PORTLAND, CONNECTICUT
DISTRIBUTORS AND WAREHOUSE STOCKS COAST TO COAST

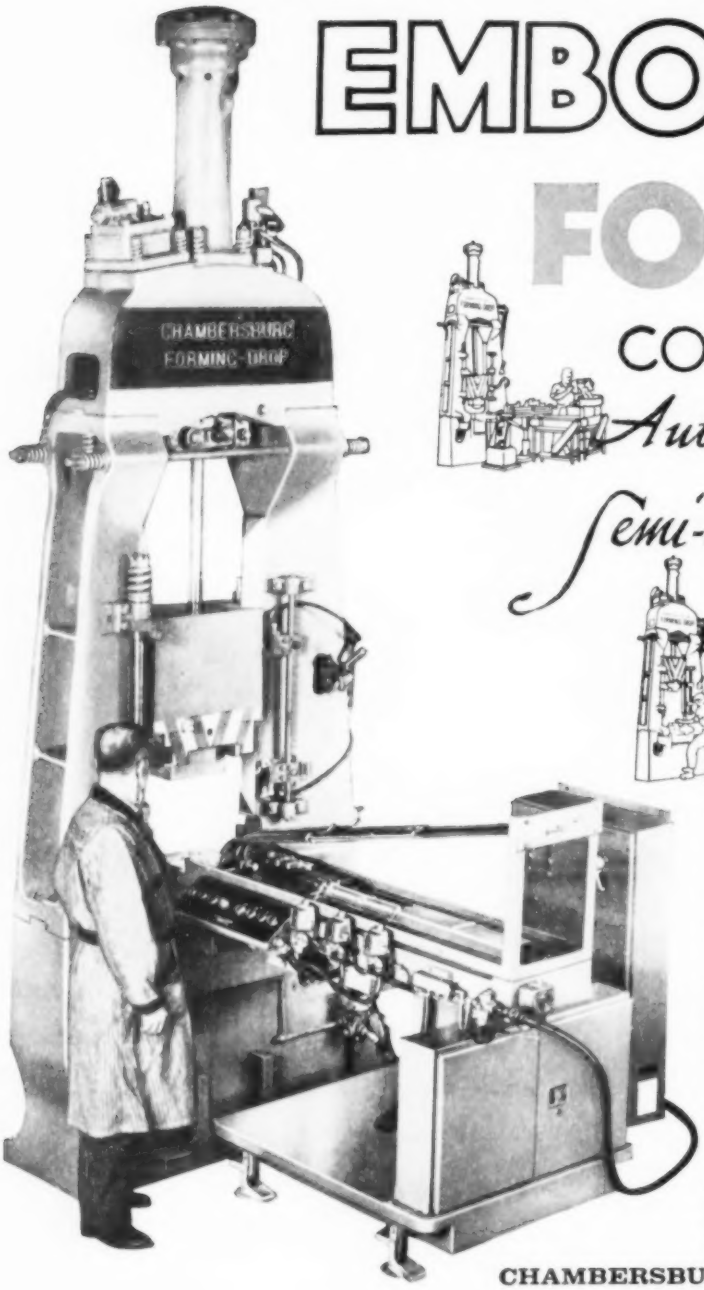
BETTER PRODUCTS FOR BETTER METALWORKING

COINING
EMBOSSING
FORMING
COLD STRIKING

Automatically

Semi-automatically

Manually



The new Chambersburg Forming Drop meets the demand for an accurate, high production hammer for coining, embossing, forming and cold striking. The impact blow, which minimizes springback, can be precisely adjusted to suit particular job requirements. Electric controls permit the use of versatile feed devices increasing operator safety and efficiency.

A Chambersburg representative will be glad to show you a film depicting this new production method. Phone or write for further details.

CHAMBERSBURG ENGINEERING COMPANY
CHAMBERSBURG, PA.

CHAMBERSBURG
FORMING DROP

Field Report . . .

Martin Missile Contract

Company has received a $2.4 million order for expansion of the Air Force TM-76B Mace missile program. The surface-to-surface tactical weapon, currently being test flown, uses an inertial guidance system that is completely self-contained and invulnerable to enemy jamming.

Martin's shift from production of military aircraft to missiles and electronic systems is well advanced. Last year company's sales were 59% in the field of missiles and electronics and 41% in manned aircraft; 72% of the 1958 year-end backlog was in the new field, 28% in manned aircraft. New missile plants have been built and staffed at Denver, Colo, and Orlando, Fla, during the past three years, and facilities of the Baltimore plant have been completely modernized. Total employment at all Martin divisions at the end of 1958 was 33,050 as against 27,269 a year earlier.

Nice Ball Bearing Burgeons

Company has started its fourth major expansion since WW II with construction on a 30-acre site in Montgomery County, Penna. Completion is scheduled for next Oct. Initial 40,000 sq ft which the new plant will provide will serve primarily as a facility for manufacture of screw machine components. Future plans call for a plant of 275,000 sq ft.

(Continued on p 208)

"Ready, Gus?"

CUT TIME! CUT COSTS!
CUT ALMOST ANYTHING
IN SECONDS!

No. 20 Manual-Operated Model

No. 14 Power-Operated Model

Speed Cut

Abrasive Cutting Machines-MANUAL OR POWER-OPERATED MODELS FOR WET, DRY OR ANY-ANGLE CUTTING!

Speed Cut

Send for complete catalog and name of nearest distributor

ABRASIVE MACHINE DIV.
BEAVER PIPE TOOLS, INC.
DANA AVE.
WARREN, OHIO

DOW | MAGNESIUM

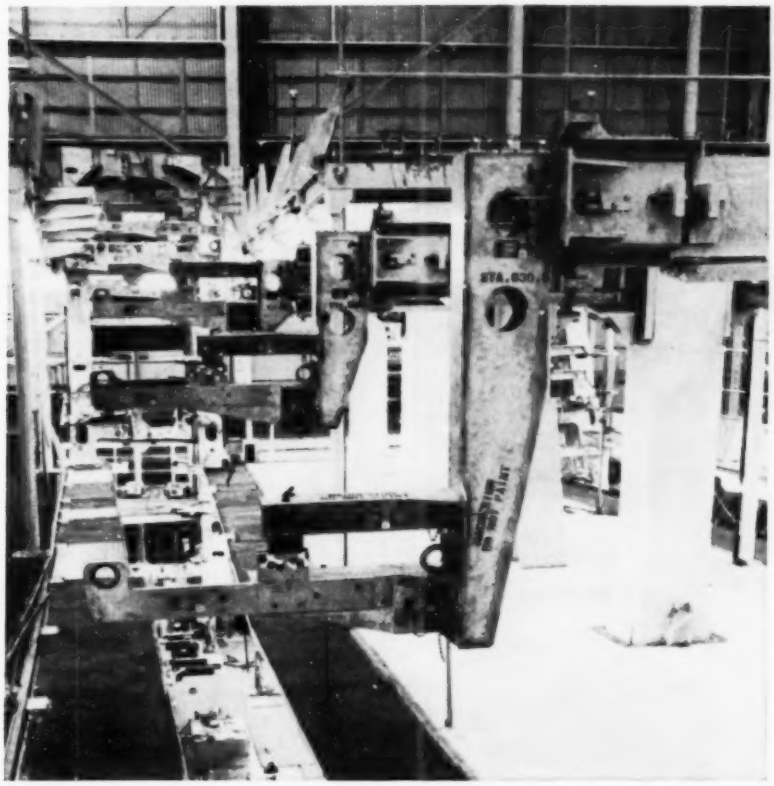
NEW BOEING 707 is first JET to fly in commercial service in the U. S. Extensive use is made of magnesium tooling plate in building the 707.

LIGHTER, FLATTER MAGNESIUM TOOLING PLATE

helps build new jet airliner

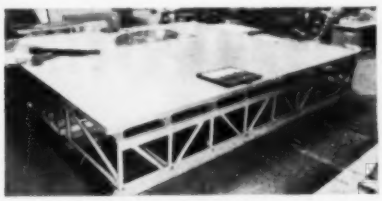
The use of magnesium tooling plate increases rapidly as more and more plants discover its important benefits. Weight savings, precision flatness, fast machining and dimensional stability are reasons for its use in many applications. Take Boeing, for example . . .

Magnesium tooling plate and extruded channels are in widespread use at Boeing's Renton, Washington, plant where the new 707 jet airliner is manufactured. Welded magnesium plate and channel are used as parts for an overhanging wing jig (see photo). Because of magnesium's lightness, such locators can be long and yet be rigid. Furthermore this lightness results in a less



severe load on the basic structure permitting it also to be lighter and less expensive. Other magnesium jigs which can be positioned and put in place by hand can easily be positioned without mechanical equipment. If made of steel, a sizable working party or a crane would be needed each time they were moved.

The top of a 20′ x 20′ master template table at Boeing was constructed of two thicknesses of 1½″ magnesium plate. No machining was required on the plates, permitting a substantial cost savings over a previous master template table made of steel plate, which required considerable machining. The stability of magnesium has maintained the necessary tolerances during use. A large 707 door locating jig also made of magnesium tooling plate can be handled by two men, and can be easily stored when not in use. The stability of welded magnesium structures in this and other applications is invaluable for large assembly jigs.



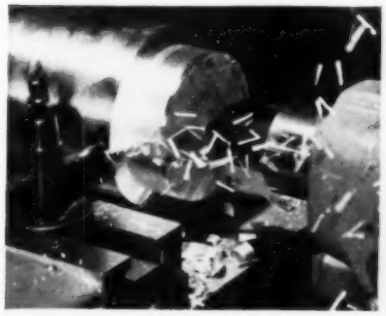
* * *

The lightness, flatness, stability and stiffness of magnesium tooling plate have likewise greatly increased its use as a base plate for plaster forms.

There are other advantages that make lightweight magnesium desirable as tooling plate material: Manually positioned welding jigs are easier to handle, weld spatter doesn't stick, high heat conductivity prevents warping from local heating, and nonmagnetic magnesium used for spot welding jigs causes no interference. Wherever magnesium tooling plate is used, it means less frequent use of lift trucks and other power handling equipment.

* * *

NEW MAGNESIUM TOOLING PLATE MANUAL. This handy, fact-filled reference book covers shop working characteristics, properties, design, etc., for magnesium tooling plate and tubing. For your copy, contact any Dow sales office or write to Magnesium Sales, THE DOW CHEMICAL COMPANY, Midland, Michigan, Department 1330F4-20.

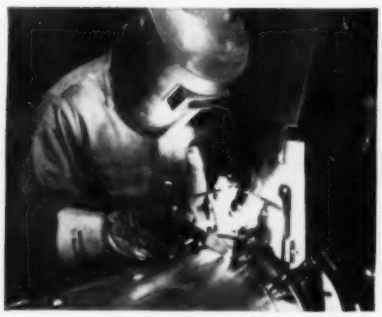


MACHINING TIME CUT TO SHREDS

Drilling, milling, reaming, sawing and other machining operations can be performed on magnesium with surprising economy. Magnesium machines faster and easier, reducing production time and tool wear to a minimum.

MAGNESIUM PLATE RESISTS BURNING

An acetylene torch fails to sustain ignition of magnesium tooling plate, even after prolonged contact. Reason: Heat is conducted rapidly away from point of application. Hundreds of metalworking plants work with magnesium tooling plate every day, yet the incidence of fires attributed to magnesium is very small.



LONG SUIT: WELD STRENGTH

Magnesium tooling plate is easily joined by inert gas arc welding. High strength welds and joint efficiencies up to 95% are common. Any joint commonly welded with steel can be welded with magnesium, allowing exceptional versatility for tooling jobs. Magnesium can also be joined by common methods of mechanical fastening.

THE DOW CHEMICAL COMPANY · MIDLAND, MICHIGAN

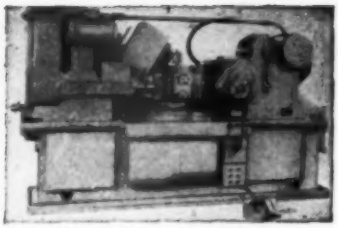
Here's what is meant

by

"1·2·3"

in the

GOSS & DE LEEUW AUTOMATIC CHUCKING MACHINE



The outstanding advantage of this machine is ability to handle operations on one, two or three ends of a piece *simultaneously or in sequence, without changing set-up or rehandling*. It is the only standard machine that will do this.

"1-2-3" means ability to handle work requiring machining operations on one, two or three ends simultaneously or in sequence—a method exclusive with Goss & DeLeeuw and offered on this machine.

For complete details ask for illustrated bulletin. Send samples of your work for time and cost estimates.

GOSS and DE LEEUW

MACHINE COMPANY. KENSINGTON. CONN., U.S.A.

Field Report . . .

Martin's 5-lb Atomic Generator Wins Miniaturization Award

Nuclear Division of the Martin Co, Baltimore, has been named winner of the 1958 Miniaturization Award for development of the SNAP-III, a 5-lb atomic generator that will produce electricity during its lifetime equal to that furnished by nickel-cadmium batteries weighing 300 times as much. Award, established in 1957, and sponsored by Miniature Precision Bearings, Inc, of Keene, NH, was presented by Horace D Gilbert, chairman of the Awards Committee and president of MPB.

Committee, made up of representatives from government, the armed forces, education, and industry, also presented certificates of excellence in miniaturization to V K Zworykin, Rockefeller Institute, New York; Elgin Micronics, Division of Elgin National Watch Co, Elgin, Ill; Robert W Yancey, Electronics Division, Research Dept, Naval Ordnance Laboratories, Corona, Calif; Peter J Pijoan and John Buckley, Westinghouse Electric Corp, Air Arm Division, Baltimore, Md; Sonotone Corp, Elmsford, NY; Patek Philippe & Co, Advanced Research Division, Geneva, Switzerland; Keith O Johnson, Stanford University, Calif; Heald Machine Co, Worcester, Mass; Servomechanisms, Inc, Applied Research Laboratory, Goleta, Calif; Diamond Ordnance Fuze Laboratories, Washington, DC.

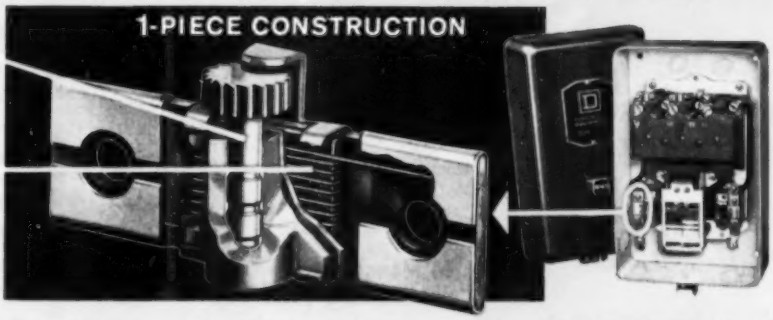
(Continued on p 210)

"This one is marked $22,379.50."

When you buy Motor Starters --

YOU PAY FOR OVERLOAD PROTECTION

...BE SURE YOU GET IT!



Heat-responsive element (solder pot) provides accurate response to overload, yet prevents nuisance tripping.

Heat-producing element is an integral part of overload unit. It's permanently joined to solder pot, can't become misaligned.

Only ONE-PIECE Overload Relays can give 100% Protection Only with ONE-PIECE construction can you *know* you've installed the heater correctly. Only with ONE-PIECE construction can you *know* the heater is exactly centered, or properly positioned, so that it performs according to its rating. Only with ONE-PIECE construction can you *know* your starters will not operate without the thermal units properly installed. Only with ONE-PIECE construction can you *know* your motors have full protection.

Only Square D has ONE-PIECE Construction ONE-PIECE construction *eliminates* any possibility of heater misalignment. Square D melting alloy thermal overload relays can be installed only one way. They are tamper-proof. They are factory-assembled, are *individually* calibrated and tested. Repeated tripping will not affect their accuracy.

Insist on Square D starters with melting alloy thermal overload relays

Let your Square D Field Engineer show you 1 how one-piece construction is accomplished and how easy it is to mismatch separate heaters and solder pots— 2 an endurance tester to prove that overload units can be reset repeatedly without damage while the solder is liquid — 3 a tripping time tester to compare various types of melting alloy units and to prove that tripping time won't change after repeated operation.

Individual factory inspection of every Square D melting alloy thermal overload relay means performance you can trust. Each unit is calibrated and thoroughly tested to make sure it will perform according to its rating.

***Write** for Bulletin SM-275 for the complete story on Square D starters with ONE-PIECE thermal overload relays. Address Square D Company, 4041 N. Richards St., Milwaukee 12, Wisconsin*

SQUARE D COMPANY

Large or small INDUSTRIAL CUT GEARS

- FURNISHED COMPLETE
- CUSTOM CUT FROM YOUR BLANKS
- HEAT-TREATED, CASE OR FLAME-HARDENED

SIMONDS GEAR produces a complete line of industrial cut gears in a full range of sizes from cast or forged steel, gray iron, bronze, Meehanite, rawhide or bakelite. Also heat-treated, case or flame-hardened carbon or alloy steel. Or, you may have your own gear blanks custom cut to your order. Same quality . . . same prompt service. Send us your requirements for quotation.

ALSO stock carrying distributors of Ramsey Silent Chain Drives and Couplings; and industrial V-belts.

SPUR GEARS • BEVEL GEARS • MITRE GEARS
WORMS • WORM GEARS
RACKS
PINIONS

SIMONDS GEARS

THE SIMONDS GEAR & MFG. CO.
LIBERTY at 25TH PITTSBURGH 22, PA.

Quality Gears for Over 65 Years

Field Report . . .

Convair Designing Airframe For Nuclear Powered Bomber

Air Force has designated Convair Division of General Dynamics Corp as designer of the airframe for a nuclear powered bomber. Nuclear aircraft program has been mainly concentrating on development of a propulsion system, rather than the aircraft body itself. Nuclear Propulsion Division of General Electric has the contract for this; Convair will work with GE in the airframe design work.

Burroughs Buzzing

A $2.6 million contract for teletypewriter type equipment is being handled by Burroughs. Order calls for 1900 teletype units to be built at the Detroit plant.

LFM Manufacturing Co Completes Big Expansion

LFM, a Rockwell subsidiary, has put the finishing touches to its $3 million, two-year program of rebuilding all prior facilities, plus a 50% expansion of area. The Atchison, Kan, facility, reported to be the largest electric steel foundry under one roof, can now ship 3000 tons per month. Equipment includes the biggest type of electric furnace used by steel foundries; a mechanized slinger mold department; pneumatic core sand transport system; and pneumatic core sand reclamation system.

(Continued on p 212)

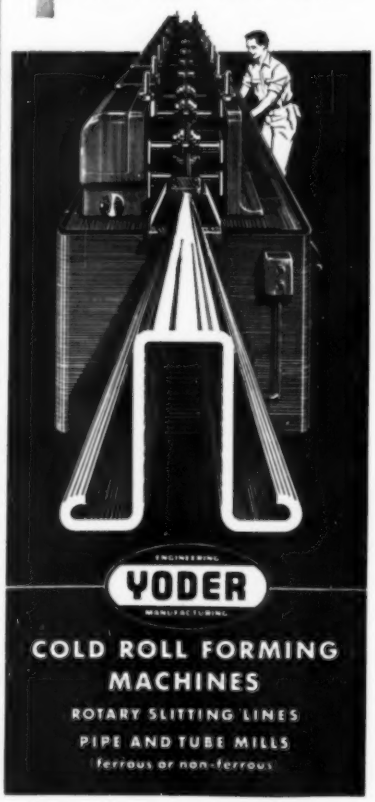
"I've been trying for years to get the shop on a paying basis—but I keep running out of money!"

YODER

Roll Forming Equipment—Product dependability—integrity of manufacture—engineering for specific production needs have all contributed to establish Yoder equipment as the industry standard of excellence. Since 1909 Yoder-built machinery, including Pipe and Tube Mills, Roll Forming Equipment and Rotary Slitters, have earned world-wide customer satisfaction and recognition.

Profit from Yoder's years of engineering and service experience. Send today for the illustrated Yoder Roll Forming Equipment Book.

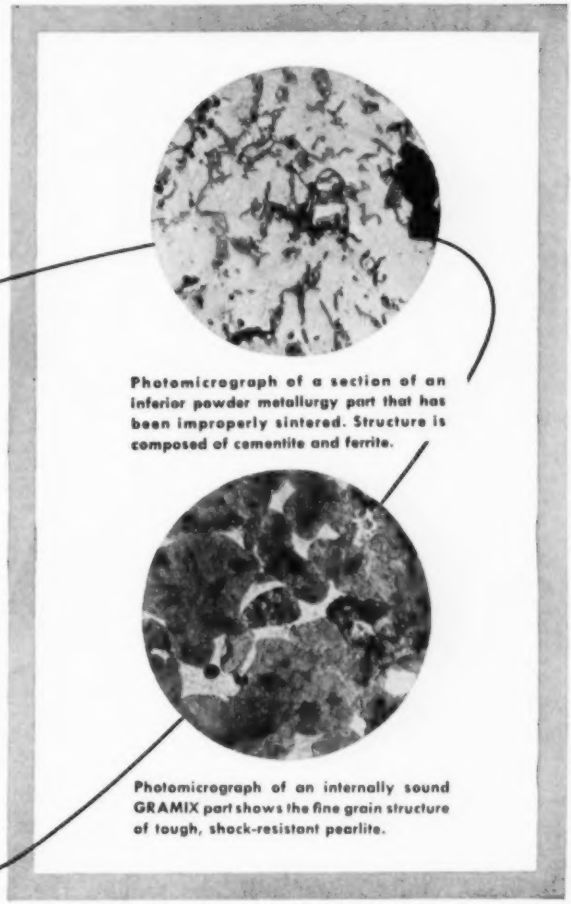
THE YODER COMPANY
5519 Walworth Ave., Cleveland 2, Ohio



COLD ROLL FORMING MACHINES
ROTARY SLITTING LINES
PIPE AND TUBE MILLS
ferrous or non-ferrous

CIRCLE 311 REDAER SERVICE CARD
CIRCLE 312 READER SERVICE CARD

Quality of GRAMIX® precision parts insured by metallurgical control in the laboratory *proven by performance on the job!*



Photomicrograph of a section of an inferior powder metallurgy part that has been improperly sintered. Structure is composed of cementite and ferrite.

Photomicrograph of an internally sound GRAMIX part shows the fine grain structure of tough, shock-resistant pearlite.

To assure the dependable performance of GRAMIX powder metallurgy parts in actual operation, the United States Graphite Company combines exacting laboratory tests and rigid production controls to insure the quality of every GRAMIX part. Through the use of the metallograph, for example, GRAMIX engineers can check the internal structure of a part. A comparison of the photomicrographs shown above readily shows the sound under-the-surface quality of a GRAMIX part as opposed to the poor internal composition of an improperly sintered part. In the photomicrograph at the top, notice the cementite between the ferrite grain boundaries. This cementite will tend to break up and rupture under shock. The surface of the material is decarburized and only remnants of pearlite remain. *This condition is due entirely to the lack of adequate sintering control!*

The photomicrograph of the GRAMIX part at the bottom shows a fine grain pearlite structure that's tough, strong and wear resisting. Absolute sintering control along with precise metallurgical control in the laboratory is utilized by The United States Graphite Company to positively assure quality GRAMIX parts.

Write today for these helpful engineering manuals. Engineering Bulletin No. 18 covers design and metallurgical requirements and alloy selection of GRAMIX bearings. No. 19 contains facts about GRAMIX Machine Parts and No. 21 contains general information on GRAMIX products from Powder Metallurgy. Get your copies now.

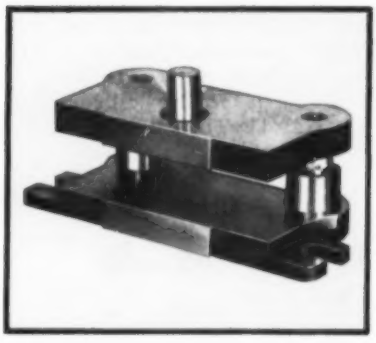
X-264-1R

THE UNITED STATES GRAPHITE COMPANY

DIVISION OF THE WICKES CORPORATION, SAGINAW 23, MICHIGAN

GRAPHITAR® CARBON-GRAPHITE • GRAMIX® POWDER METALLURGY • MEXICAN® GRAPHITE PRODUCTS • USG® BRUSHES

NOW, in addition to all the other advantages of Lempco Ball Bearing Die Sets, we've developed new special alloy ALUMINUM ball bearing retainers. 50% longer life than brass retainers and 50% less weight. The BEST has been made even BETTER! No other die sets known could equal our ball bearing die sets with BRASS retainers, now we've added ALUMINUM for phenomenal long life, millions of strokes, with a very minimum of maintenance and care.



If you're not already using Lempco Ball Bearing Die Sets, better write us today for Catalog and Price Lists.

Field Report . . .

Norfolk & Western Ry Starting $9 Million Car-Building Program

Construction will start this year on 1000 seventy-ton hopper cars; project will be added to the present 1500-car program now underway at the Roanoke, Va, shops. Company's schedule for 1960 and 1961 calls for acquisition of at least 2500 freight cars in each of those years. In addition, N&W will complete its $88 million dieselization program by end of this year.

Buick Upping Opel Imports

Monthly imports of Opel sedans and station wagons to the US have been increased subtsantially again. Buick is currently importing them at a rate in excess of 3000 cars a month, says more could be sold here if they were available from the German plant. Car is made by Adam Opel A G, a General Motors subsidiary at Russelsheim in the Western Zone.

$20 Million Missile Contract Goes to Western Electric

Order for continued production of the Nike-Hercules has been received by WE. Company builds the electronic brains of the missile at its plants in Winston-Salem, Greensboro, and Burlington, NC. Actual construction of the 5-ton weapon is subcontracted to Douglas Aircraft's Charlotte plant.

(Continued on p 214)

"Until I met you I had always thought of coffee as a stimulant!"

MOLYKOTE®
LUBRICANT metalworking news

PUNCH LIFE INCREASED FROM 2,000 to 25,000 HOLES IN STEEL PLATE

These punches (11/16") were used to punch 25000 holes in ½", 1020 cold rolled steel plate. Without MOLYKOTE Lubricants a maximum life of only 2000 holes could be obtained.

A West Coast manufacturer was experiencing low punch life with the best conventional lubricants. Their multiple punching operation consisted of cold shearing 50 holes simultaneously in a single steel plate. A maximum life of 2,000 holes per punch was obtained with ordinary lubricants.

Then, MOLYKOTE Type G was applied to the punch occasionally. The result: punch life was increased from 2,000 to 25,000 holes which afforded substantial savings.

When writing, refer to Item 508

"A LITTLE BOTTLE FOR A BIG JOB"

- **For Extending Die Life.**
- **For Preventing Metal Pickup.**

Try it . . . Order a 10 ounce container of MOLYKOTE Type Z TODAY!

MOLYKOTE CANNOT BE SQUEEZED OUT REGARDLESS OF PRESSURES; EXCELS AS COLD-FORMING LUBRICANT IN METALWORKING

Distortion, Stick-Slip and Fretting Eliminated • Mounting Loads Reduced • Chatter and Noise Avoided • Allows Easier Disassembly

In metal forming the most difficult problem to overcome is scuffing from metal pickup on the dies. Direct contact of bare surfaces of a piece undergoing formation with the die often results in galling, scuffing, etc. If the surfaces can be separated by a lubricant of sufficient film strength, metal pickup does not occur.

Before new dies are used, burnish them with MOLYKOTE Type Z. If the lubricant you are now using does not have sufficient film strength and galling does occur, use MOLYKOTE on your dies.

The automobile industry which forms and fabricates vast tonnages of various metals, uses MOLYKOTE Type Z extensively.

When writing, refer to Item 505

Applying MOLYKOTE Lubricant to feed stock at the Bassick Company, Bridgeport, Conn., in a forming operation.

DAMAGE DUE TO IMPROPER MACHINERY "WEAR-IN" CAN BE ELIMINATED WITH NEW COMPOUND

Wear-in damage is often serious enough to require costly reconditioning of new equipment and if the damage is not repaired, it will interfere with and reduce the useful service life of expensive machinery. During this critical wear-in period, damage due to galling, scoring, tearing, scratching, excessive abrasion and seizing is an inherent hazard. MOLYKOTE WEAR-IN COMPOUND is the most effective lubricant yet developed to combat this damage.

In seven different ways, MOLYKOTE WEAR-IN COMPOUND saves you time and money:

1. **Shortens "wear-in" period without use of abrasives.**
2. **Reduces galling, seizing and excessive wear during the critical "wear-in" period in new or rebuilt machinery and after the installation of re-replacement parts.**
3. **Offers the best safeguard against costly reconditioning work and shipping delays due to the "breaking-in" of new machinery.**
4. **Eliminates "stick-slip" behavior and resists galling and seizing at bearing pressures far beyond the yield point of any metal.**
5. **Specifically designed for "wear-in" use. MoS_2 particles make intimate contact with bearing surfaces. Will not scrape off.**
6. **Need not be burnished into surface. Brush or wipe on a thin coating.**
7. **Inexpensive . . . a little goes a long way.**

When writing, refer to Item 506

Address your letter to The Alpha-Molykote Corp., 65 Harvard Ave., Stamford, Conn.
Phone: FIreside 8-3724.

SEE OUR CATALOG IN SWEET'S

THE ALPHA-MOLYKOTE CORP.
Stamford, Connecticut
Please send me details on

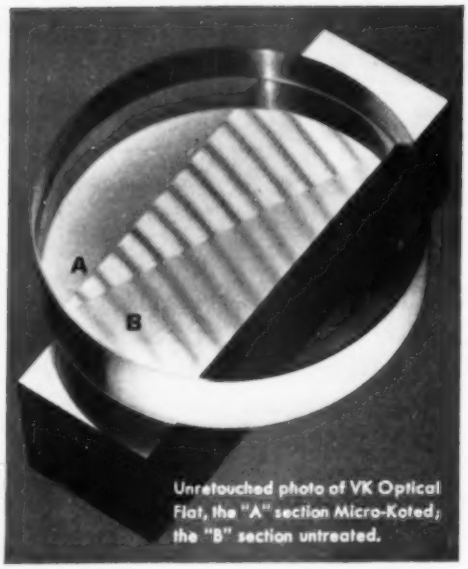
Item 505 ☐ **Item 506** ☐ **Item 507** ☐ **Item 508** ☐

Name .....
Company .....
Address .....
City .....
State .....

MOLYKOTE® LUBRICANTS

BREAKING LUBRICATION BARRIERS ...THROUGH RESEARCH

Checking surface flatness **down to 1/10 of a band?** (.000001-inch) You can do it easily with the



Unretouched photo of VK Optical Flat, the "A" section Micro-Koted; the "B" section untreated.

VAN KEUREN MICRO-KOTED* OPTICAL FLAT

Elimination of the fuzzy edges of the interference bands gives you *greater precision* and *readability*... and faster checking, too, because you get the pattern quicker. There's stronger contrast, a brighter field. The narrow band, very black and sharp-edged, has a width corresponding to a height difference of about .000001".

Having several times the effectiveness of ordinary flats, you might think that VK Micro-Koted Optical Flats are expensive — but that's where you'd be wrong. They cost only 10% to 15% more than uncoated flats. They do not require special handling; they have amazingly long life. One user checked more than 10,000 pieces of permanent magnetic material (carbon seals and Alnico seals) without any appreciable wear. Speaking of VK Micro-Koted Flats, one man said, "It makes a hell of a difference! We wouldn't buy a flat *unless* it was Micro-Koted!" That's the kind of compliment that makes us do our best!

Originated by Van Keuren in 1957, these Micro-Koted flats are perfect for checking bronze, brass and other metals used for magnetic seals, and for checking other critical parts, for surface flatness.

Write today for descriptive leaflet, "Micro-Koted Flats".

* VK Micro-Koted Optical Flats are treated on one side with a transparent layer of hard metal.

VK

THE Van Keuren CO.
Since 1920
173 Waltham Street, Watertown 72, Mass.
PRECISION MEASURING TOOLS
... rated the world's most accurate
Plug Gages · Measuring Wires · Optical Flats and Light Wave Equipment · Gage Blocks · Precision Lapping Service and Parts

Field Report . . .

Industry Notes from the South . . .

Vulcan Metal Products, Inc, will put up a new $300,000 manufacturing plant in Birmingham. Company processed more than 36 million lineal feet of aluminum shapes last year. Among its products are screens, doors, storm sash and porch enclosures . . . **Georgia Power Co,** Atlanta, is beginning operations in its new $4 million general repair shop and construction headquarters. More than 300 workers will be based at the new quarters located just outside the downtown district . . . **Daniel Radiator Manufacturing Co** is building a plant in Atlanta to produce auto radiators . . . **Perfection Metals Co** has begun fabrication at Lilburn, Ga . . . **Aluminum Ladder Co,** Worthington, Penna, is relocating its entire operation in Florence, SC . . . **Cincinnati Sheet Metal Co's** Nashville branch is moving into a new 52,000 sq-ft building, more than double the size of its former quarters . . . **Southern Transformer Co,** a new Tenn firm, plans to occupy a $140,000 building to be constructed in Huntingdon, Tenn. Company will build and repair electric transformers.

Live Longer at Allis-Chalmers

New low accident frequency rate of 4.0 showed up at A-C in 1958, a reduction from 6.2 in 1957. Company-wide severity rate of 289 stood up splendidly against the 513 mark chalked for 1957. At West Allis, company's largest works, reduction last year was 37½% lower than the 6.4 frequency record of 1957. This meant that 106 employees lost work through plant mishaps compared with 201 the year before. Company keynotes its yearly campaigns with slogans, "Knowing's Not Enough," "Use Your Know-How"; plugs separate safety rules each month with folders containing case histories of accidents taken from company files.

GE's Lynn, Mass, Works . . .

. . . has a $4 million Air Materiel Command contract assigned to its Small Aircraft Engine Dept for improvement of the T-58 engine. Also at Lynn, the Medium Steam Turbine, Generator, and Gear Dept plans to build a $600,000 steam turbine balance test facility.

4-Year Expansion Started By Acme Steel Co

Estimated cost of $40-$45 million expansion and improvement is on the books at Acme. Modernization of No. 2 hot strip mill at Riverdale, Ill, will be started this year and plans call for hiking steelmaking capacity there by next year that would up ingot capacity from 450,000 to 675,000 tons annually. Company completed a 5-year program of expansion and diversification last year which required a capital outlay of $50 million.

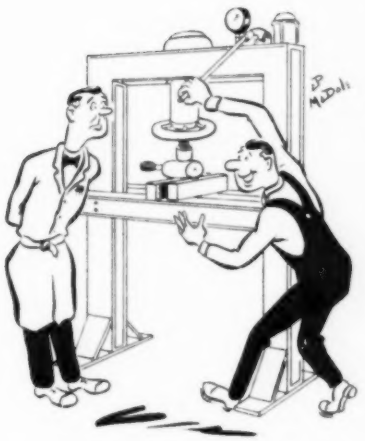
Ingalls Shipbuilding Corp . . .

. . . Pascagoula, Miss, has started work on the third of five C3 general cargo vessels for Lykes Bros Steamship Co. Ships, scheduled for delivery during 1960, are part of a half-billion-dollar fleet replacement program initiated by Lykes last year. Replacement will mean construction of 53 vessels over the next 14 years.

Shell Chemical Installing Radiation Unit

Newly developed radiation unit called Hotrodder Model U has been purchased by Shell Chemical Corp from Nuclear Systems, a division of Budd Co. Shell is installing the 26,000-lb unit at its synthetic rubber research center at Torrance, Calif. Gamma rays from the cobalt 60 source will be used to start and modify chemical reactions in a search for improvements in rubber and plastics.

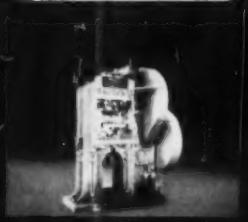
(Continued on p 217)



"I'm making an oval gage for my egg-shaped holes."

IMPROVE YOUR PROFIT PICTURE WITH BEATTY EQUIPMENT

GUILLOTINE BEAM PUNCH
Punches flanges and webs of beams. Full capacity loading and punching across face of ram. 150, 200 and 350 ton models.



NO. 7 DETAIL FLANGE PUNCH
100-ton punch, flange-punches I-beams in only 2 passes instead of 4 — eliminates the end-for-end turning of beams. Punches 1¼" hole through 1" mild steel.

GUILLOTINE BAR SHEAR
For production or short run shearing of rounds, squares, angles and bars without changing tools. 43 to 300 ton capacities.

When "CUT COSTS" is the order of the day, look to Beatty heavy metal-working equipment to brighten your profit picture. Punching, slotting, bending, flanging, forming, shearing — whatever your metal-working job, Beatty machines are engineered to give you fast, accurate production.

But you will never know the costs you can save — the manpower you can save until you put a Beatty machine to work in your shop. For either 24-hour-a-day operation or intermittent use, they're bears for work — require a minimum of maintenance, reduce downtime — cut costs on any metal-working job.

When "CUT COSTS" is the order of the day, tool up with Beatty equipment, for efficient, low-cost metal fabricating.

Write For Free Literature

PUNCHES • PRESSES SHEARS

BEATTY

MACHINE & MFG. CO.

948 150th St., Hammond, Indiana

RIVETT SQUAREMASTER "100" CYLINDERS

Unfailing POWER for MILLIONS of cycles!

Here's sure power for unfailing cylinder operation. SQUAREMASTER 100's are the world's finest constructed cylinders—perform with 100% efficiency! 200 P.S.I. air to 500 P.S.I. oil. Available in 7 mountings with standard dimensions, in 10 bore diameters, internal and external threading. Special models and cover combinations. Priced competitively; prompt delivery; meet all J.I.C. requirements.

RIVETT, INCORPORATED

Dept. AM-4, Brighton 35, Boston, Mass.

*Initial High Coefficient of Static Friction

POWER-PACKED FEATURES PROTECTED BY POWER-GUARD CONSTRUCTION

1. Piston rod. Ground and polished alloy steel. Hard chrome-plated. **2.** Piston rod bearing. Replaceable cartridge-type. **3.** Piston packing adjusts automatically. V-block packing minimizes friction. **4.** Correctly stressed tie rods. **5.** Cushion bushings. Bronze, floating type. **6.** Ports rotated to any 90° position. **7.** Steel covers. Take minimum mounting space.

Send for catalog. Proof of SQUAREMASTER efficiency stated in these 20 pages. Write today.

RIVETT

furnishes a complete power package

AIR AND HYDRAULIC — VALVES, CYLINDERS, POWER UNITS

Member — National Fluid Power Association

Field Report . . .

Tooling Production Specialists

New Venture Designs has been formed in Brampton, Ontario, to provide a complete tooling and production service. Company is qualified to specialize in tool design, planning, and other allied production fields, ranging from jig and fixture and cutting tool design to special purpose machine design.

Commonwealth Plastics Corp . . .

. . . has formed a subsidiary, US Dielectric Products, Inc, that'll design prototypes and turn out plastic products for antenna, electronic, and aircraft use at Leominster, Mass.

Sprague Electric Co . . .

. . . North Adams, Mass, has bought the magnetic compound and filter product lines of the Hycor Division of International Resistance Co, Philadelphia.

Air-Formed Products Corp .. . .

. . . has been formed at Nashua, NH, for design, manufacture, and sale of equipment and services to the plastic blow molding industry.

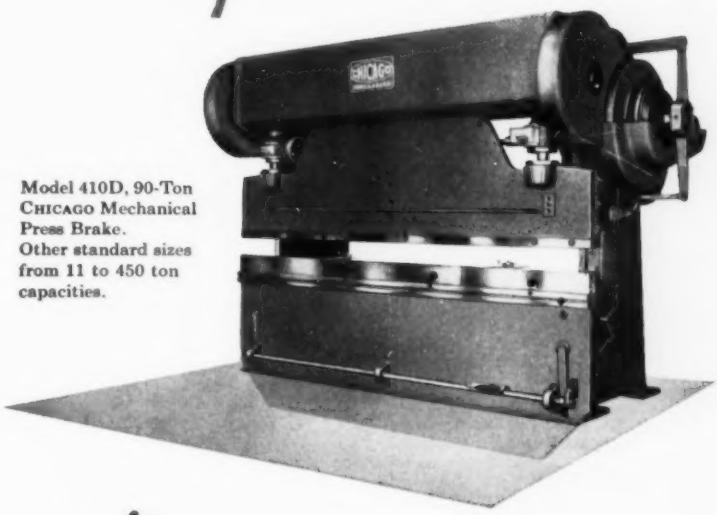
National Research Corp . . .

. . . Cambridge, Mass, has set up a Metals Division to market high purity tantalum and its alloys and other rare metals and related chemicals.

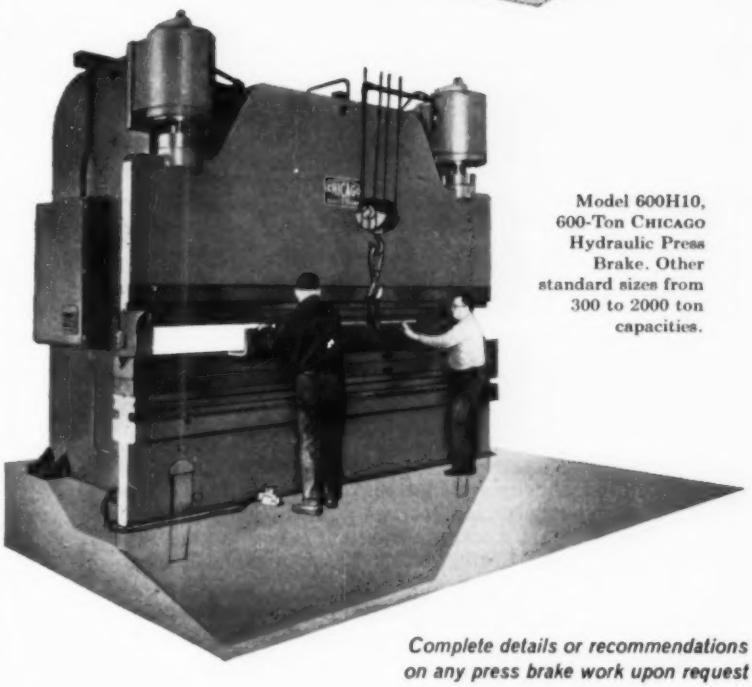
"I may be home a little oily tonight, dear."

CHICAGO® PRESS BRAKES

unexcelled accuracy / ***for sheet metal and plate work***



Model 410D, 90-Ton CHICAGO Mechanical Press Brake. Other standard sizes from 11 to 450 ton capacities.



Model 600H10, 600-Ton CHICAGO Hydraulic Press Brake. Other standard sizes from 300 to 2000 ton capacities.

Complete details or recommendations on any press brake work upon request

8439

Press Brakes
Press Brake Dies
Straight-Side-Type Presses
Hand and Power Bending Brakes
Special Forming Machines

CHICAGO DREIS & KRUMP

DREIS & KRUMP MANUFACTURING CO.
7434 S. Loomis Blvd., Chicago 36, Illinois

CIRCLE 319 READER SERVICE CARD

Now

AUTOMATIC POSITIONING

with the

DIXI 75 horizontal optical jig borer

offers you increased

ACCURACY

VERSATILITY

PRODUCTIVITY

Made in Switzerland
Measurement in inches

- Automatic positioning can be changed instantly to manual operation
- Projected optical setting — direct reading to .00005" for linear motions and 1 sec. of arc for built-in rotary table. Linear optics provided with adjustable zero reference
- Simplified controls functionally arranged for greater operating speed and efficiency
- 3" diameter boring spindle
- Increased capacity: table size 39⅜" x 32"; 29⅝" cross travel; 23⅝" longitudinal travel; 25⅝" vertical travel
- Hydraulic feeds and infinitely variable spindle speeds
- Rear support optional

MBI has engineers available for consultation, guarantees service by factory trained staff, and stocks spare parts in New York.—Join the long list of leading aircraft and manufacturing plants throughout the United States which are using the horizontal optical jig borer.

Demonstrations upon request at our conveniently located demonstration centers.

MBI

M. B. I. EXPORT & IMPORT LTD.

A DIVISION OF MACHINERY BUILDERS, INC.

475 Grand Concourse, Bronx 51, N. Y.

"Over 25 years' experience in designing and building machinery."

Free Literature

To order any of these bulletins, circle corresponding number inside back cover.

MACHINES AND ATTACHMENTS

1 AUTOMATIC TRACING LATHE—*Jones & Lamson Machine Co, Springfield, Vt.* 8-page brochure provides information on Model 30 Auto-Tracer. Describes automatic tracing cycles, variable components available, design features and specifications. Controls for quick setup and operation are explained.

2 COMPOUND FOR SCHAUBLIN LATHES—*Carl Hirschmann Co, 30 Park Ave, Manhasset, NY.* Bulletin contains illustrated information on newly designed compound for the SV-70 lathe. Gives general specifications of screw or lever operated carriages featuring micrometer spindles with fully protected ground and lapped leadscrews supported at both ends, or as a lever-operated carriage with stop screws on both slides and true center line application of power.

3 SCHAUER SPEED LATHES — *Schauer Manufacturing Corp, 4500 Alpine Ave, Cincinnati 42, Ohio.* 16-page catalog 580 describes and illustrates complete line for polishing, lapping, deburring, and other secondary finishing work on metal and plastic parts. Covers bench and floor units incorporating fixed or variable speed motors, with collet, chuck, and vacuum holding fixtures.

4 MOLDING MACHINES — *Hydraulic Press Mfg Co, Mount Gilead, Ohio.* 6-page bulletin 5830-A gives details on line of machinery for molding plastics. Includes injection models (both conventional and preplasticizing); compression, transfer and reinforced plastics molding presses; and special machines. Pictures different types, and shows machines doing on-the-job molding. Complete specifications for all standard units included.

5 WIRE DRAWING MACHINE—*R S Watkins & Sons, Glen Rd, Sandy Hook, Conn.* 4-page illustrated bulletin gives information on a four-roll tandem unit with step rolls, silent chain drive, fabricated frame, circulating cooling system.

"I won't be long—just a five-minute lecture on how rough things were in the old days before automation. A short talk on the value of perseverance and a few moments of hemming and hawing . . . then he'll give me the afternoon off."

6 INDEXING MACHINE CHASSIS — *Swanson-Erie Corp, 814 E 8th St, Erie, Penna.* 8-page illustrated brochure explains advantages of turret type chassis (Series B and C) for special purpose processing and assembly machines. Points up important features, gives dimensional specifications and operational data, and shows typical examples of how they are used for machines that perform a variety of automatic operations.

7 AUTOMATIC ASSEMBLY MACHINES—*Ferguson Machine Corp, 7818 Maplewood Industrial Court, St Louis 17, Mo.* 10-page bulletin 601 illustrates and discusses methods of tooling machines with slow cyclic rates to produce multiple assemblies simultaneously, and the design of equipment which can, with minor changes, be adapted for production of different but basically similar items. Provides informative data on combining manual and automatic methods as an interim step toward full automation; integration of parts manufacture and assembly on a single machine; and use of standard machine bases and fixtures.

8 POWER PRESSES—*Famco Machine Co, 3100 Sheridan Rd, Kenosha, Wis.* Bulletin describes new line incorporating pneumatic friction clutch and brake. Bench and floor models covered; specifications tabulated.

TOOLS AND ACCESSORIES

9 SOLID CARBIDE TOOLS — *Atrax Co, Newington 11, Conn.* 148-page catalog 159 contains engineering data and prices on 1230 standard-stock solid carbide tools and burs, speed and feed charts, machining recommendations for all tools, and metalworking production hints.

10 CARBIDES—*Adamas Carbide Corp, Kenilworth, NJ.* 32-page catalog 359 describes and illustrates complete line of tungsten carbide tools, tool tips, dies, wear parts, and Dex-A-Tools.

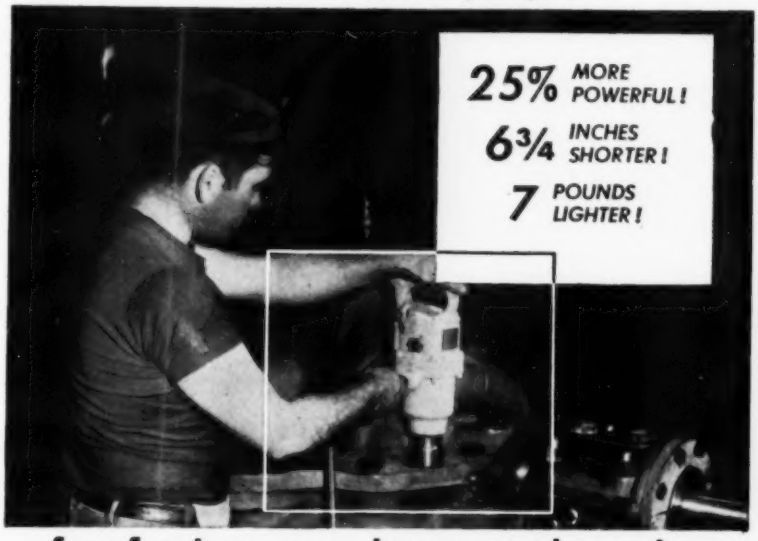
11 PROFILOMETER EQUIPMENT — *Micrometrical Manufacturing Co, 345 S Main St, Ann Arbor, Mich.* 12-page catalog 159 presents illustrated descriptions of all available instruments together with several special items which indicate the versatility of the Profilometer for measurement of surface finish. Dimensional drawings, specifications, current price list included.

12 DIAMOND GRINDING WHEELS AND HONES — *Simonds Abrasive Co, Tacony & Fraley Sts, Philadelphia 37, Penna.* 48-page revised edition of catalog (Form ESA-290) contains many additional items including consumer net prices for both man-made and natural diamonds, six additional wheel shapes, and many additions of diamond depths and concentrations. Also includes table of recommended grain and grade specifications for common operations performed in sharpening carbide tipped tools and grinding cemented carbides.

13 TILTING ROTARY TABLE—*Pratt & Whitney Co, Charter Oak Blvd, West Hartford 1, Conn.* Illustrated circular gives details on standard 24-in. model (modified for sidereal rate of rotation) equipped with an Electrolimit measuring system and special motor drive and gearing to provide a stationary platform for calibrating and testing of navigational gyroscopes.

• PUNCHING AND NOTCHING — *Wales-Strippit, Inc, 200 S Buell Rd, Akron, NY.* 16-page general catalog pictures and describes the Strippit system of punching, notching, nibbling, and drilling. Includes valid time studies of various fabrication operations using the system. Covers Strippit tooling for press brakes and stamping presses; special units such as the Fabricator, a quick-change punchpress for small-lot operations; attachments and accessories. Request direct on company letterhead.

NEW SIZE 834
IMPACTOOL
(1¼" capacity)



for faster run-down and easier handling in the tight spots . . .

Completely new design and construction of I-R's Size 834 Reversible IMPACTOOL gives you the most powerful, yet easiest-to-handle tool for any nut-running job.

New, compact, vane-type motor with direct drive to hammer provides greater torque and five times faster run-down, without transmitting kick or twist to operator. Small size and light weight make the 834 easy to use in tight, awkward positions. Yet rugged construction and strong alloy housing assure long maintenance-free tool life and efficient operation on even the toughest jobs.

Optional equipment includes Spline Drive Anvil, Swivel Inlet Assembly, Inside Trigger Handle, Side Spade Handle, and Extended Anvils.

$1,250 DIVIDEND DOLLARS
In terms of a *Dividend on Payroll Dollars*, the new I-R Size 834 can help you earn up to $1250 per operator, in one year. Ask your I-R representative for details.

FREE!
WRITE TODAY for Form 5248, describing the I-R 834 in detail. Includes in-use photos, specifications, standard and optional equipment, and accessories. Ingersoll-Rand, 11 Broadway, New York 4, N. Y.

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Tools plus AIRengineering increase output per man
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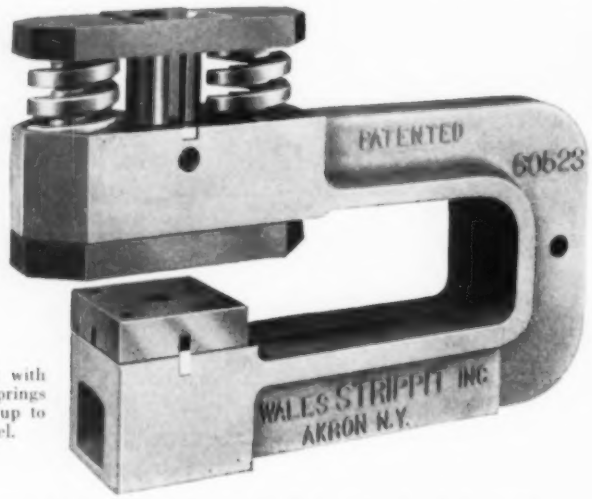
new STRIPPIT PUNCHING UNITS

with DUAL-RANGE capacity!



● Strippit unit with mechanical springs for piercing up to .500 mild steel.

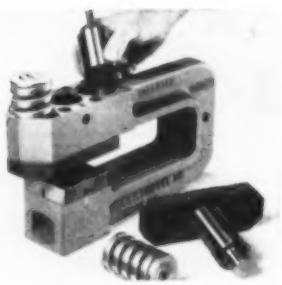
- Up to .500 mild steel, using removable Strippit mechanical springs
- Up to .750 mild steel, with interchangeable Strippit Hydra-Springs
- Convertible from .500 to .750 capacity in seconds, at minimum cost
- One heavy-duty holder for both capacity ranges
- Readily replaceable punch tips and dies — round, obround, square, shaped
- Keyed punch body keeps punches accurately aligned

USING STRIPPIT MECHANICAL SPRINGS

Max. punch dia.	Max. material thickness (mild steel)
1.375	.250
1.250	.375
1.125	.500

USING STRIPPIT HYDRA-SPRINGS

Max. punch dia.	Max. material thickness (mild steel)
1.375	.375
1.250	.500
1.125	.625
1.000	.750



◀ Mechanical springs are easily replaced with Hydra-Springs for punching up to .750 mild steel.

WRITE TODAY for the new Strippit General Catalog. It covers all details on this and all other Strippit units . . . plus the savings in tooling and press time effected with the famous cost-cutting Strippit System of fabrication.

WALES STRIPPIT INC.
200 Buell Road • Akron, New York

PUNCH-O-MATIC HOUDAILLE INDUSTRIES INC.

Manufactured in Canada by: Strippit Tool & Machine Company, Brampton, Ont.

Free Literature

To order any of these bulletins, circle corresponding number inside back cover.

14 GEAR, HOB, AND CUTTER CHECKER—*Michigan Tool Co, 7171 E McNichols Rd, Detroit 12, Mich.* 4-page illustrated bulletin 471 covers variety of uses of universal fixture including checking axial lead of worms; outside radius and concentricity of worms and worm blanks; checking milling cutters and form tools for flute spacing, sharpening accuracy, depth of form, etc; checking of spur and helical gears; rake angle and parallelism of straight fluted hobs; depth of form on milling cutters and amount of form relief.

15 CODE AND EQUIVALENT SHEETS FOR CARBIDE AND STEEL TOOLS —*M A Ford Mfg Co, 1545 Rockingham Rd, Davenport, Iowa.* 8½ x 11-in. sheets covering solid carbide and HSS cutting tools contain comparative code listing that includes numbers and dimensions assigned by the Solid Carbide Tool Institute, and also give the equivalent numbering systems of other tool manufacturers. Also available is a revised list giving the various cut grades and fluting specifications in accordance with standards of the SCTI. Chart designates number of teeth in circumference for section fluted ground tools and number of teeth per inch. Cut grades are indicated by key letters.

16 HIGH-SPEED DRILL BLANKS — *Cleveland Twist Drill Co, 1242 E 49th St, Cleveland 14, Ohio.* 4-page illustrated folder describes Mo-Max hardened and ground drill blanks available in fraction sizes from 1/64 in. to ½ in., in wire gage sizes from No. 80 to No. 1, and in letter sizes from A to Z. Lists eight sets of High Speed drill blanks as well as carbon steel sizing blanks both singly and in sets.

17 WEAR-IN LUBRICANT — *Alpha-Molykote Corp, 65 Harvard Ave, Stamford, Conn.* Bulletin 120 discusses effectiveness of Molykote Wear-In Compound in eliminating damage due to improper breaking-in of new or rebuilt machinery. In addition to this basic use, it is said to be an excellent lubricant for other friction applications in the average shop. Application method, ordering information, and prices included.

18 ONE-SHOT LUBRICATORS—*Bijur Lubricating Corp, Rochelle Park, NJ.* 8-page bulletin 3C gives information on units that supply a metered quantity of oil to a machine. Engineering drawings illustrate operational details; typical standard applications pictured.

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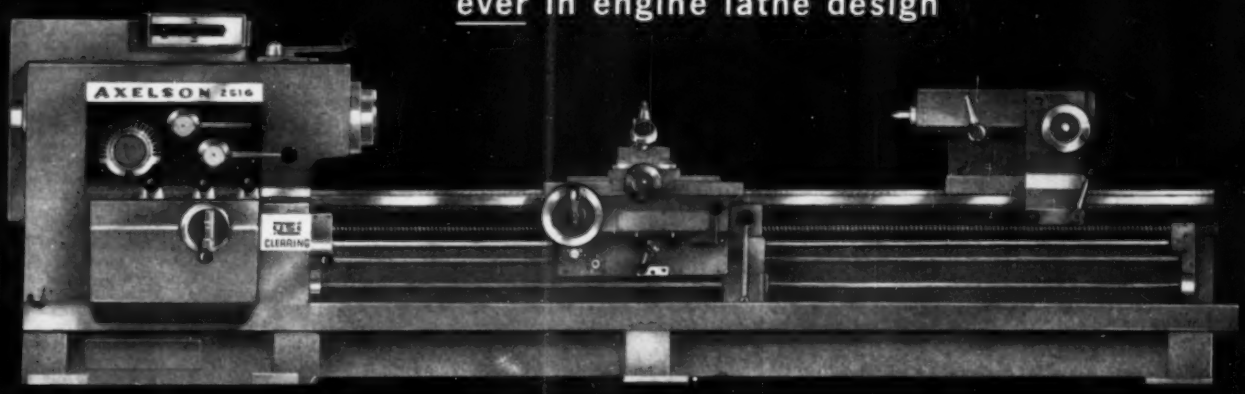
IF ANY FEATURE COULD BE IMPROVED, WE IMPROVED IT

As a result, the all new Clearing-Axelson is the greatest advance ever in engine lathe design



SHOWN ABOVE, MODEL 2516

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- **UNITIZED DESIGN CONCEPT**
  The headstock itself is built as a unit, not merely a gear box placed on the bed. Drive and Feed elements, electrical and pneumatic sections are unitized for simple servicing. Expensive service engineers from the factory are not needed.
- **ALL STEEL CONSTRUCTION**
  Stronger homogeneous steel plate gives the Clearing-Axelson the extra rigidity for extra heavy cuts—high speed work with ceramic and cemented carbide tooling.
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  All controls are grouped closer than the "strike zone" over home plate for faster speed changing.
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- **DIRECT READING DIGITAL TAIL STOCK DIAL**
  No deducting, no possibility of error. Dial reads directly in thousandths to show how deep the tool has penetrated the work.
- **TWO SPEED TAIL STOCK**
  No lost time in retracting tool from work with the high and low two speed feature.
- **ENCLOSED GEAR BOX**
  Gears are arranged to give a total of 66 feeds and threads.
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  Easily visible from anywhere the operator may be working. Shows when lathe is operating at peak efficiency.
- **4-WAY RAPID TRAVERSE**
  This feature is available as an extra on your Clearing-Axelson lathe.

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1. **Accoloy X-Weld Chain** for extra strength. X-weld hangs straight... cannot kink...has extra resistance to bending
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3. **Acco Registration Ring** is serially numbered as evidence that the sling has been proof-tested at twice its working load limit
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*Indicates Warehouse Stocks

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PLANT SERVICE EQUIPMENT

19 ABRASIVE SHOT, GRIT, AND CUT WIRE—*Cleveland Metal Abrasive Co, 888 E 67th St, Cleveland 3, Ohio.* 13-page catalog 159 lists important characteristics and uses for entire line and tabulates SAE specifications on all types. Includes discussion of methods and advantages of shot peening and impact cleaning and proper abrasive mixtures.

20 CONVEYOR SYSTEM — *Columbus McKinnon Chain Corp, Conveyor Div, Tonawanda, NY.* 6-page bulletin 159 describes and pictures the CM Power-Flex power and free overhead conveyor system that features the Teelmatic Route Selector Dispatch Head that can be furnished with each carrier. Route selector dial can be set to automatically guide a carrier to any one of 80 stations in the system.

21 BARREL FINISHING COMPOUNDS SELECTOR CHART — *Wheelabrator Corp, Techline Div, 1140 Avenue V, Vicksburg, Mich.* Chempound selector chart is designed to speed and simplify ordering of barrel finishing compounds by pinpointing the Chempound which is recommended for any given process on a wide variety of materials.

22 TRACK WHEELS AND ROLLERS —*C O Bartlett & Snow Co, 6200 Harvard Ave, Cleveland 5, Ohio.* Catalog 34 contains a stock list with specifications and data on wide line of track wheels and rollers for materials handling equipment, industrial cars, trippers, conveyors. Wheels and rollers are available with single or double flanges, straight faces, or as self-lubricated units. Size range is from 2 in. dia by $\frac{7}{8}$-in. face to 36 in. dia by 12$\frac{1}{2}$-in. face.

23 OIL-FREE COMPRESSORS — *Joy Manufacturing Co, Oliver Bldg, Pittsburgh 22, Penna.* 12-page bulletin A-44 offers information on WGO-9 heavy-duty industrial units available in 14 sizes ranging from 95.6 to 939 cfm. Included are part-designated section drawings, installation photos, and a special section on the T-Block design compression ring.

24 BUFFING AND POLISHING COMPOUNDS—*Hanson-Van Winkle-Munning Co, Church St, Matawan, NJ.* 20-page bulletin Co-104 describes more than 150 compounds and their applications. Covers products for buffing and polishing chromium, steel, and stainless, hard rubber, and plastic. Liquimatic application equipment and compounds are discussed, as well as tripolis and lime for non-ferrous metals.

25 FIRE CONTROL CHART—*Walter Kidde & Co, Main St, Belleville, NJ.* 18 x 24-in. wall chart explains the three classes of fires and approved portable extinguishers to be used on each.

26 PLASMARC PLATING—*Linde Co, Div of Union Carbide Corp, 30 E 42nd St, New York 17, NY.* 8-page booklet describes new plasma arc service for metals in the high-temp range. Plasma Arc Torch operates at temperatures up to 30,000 degrees Kelvin.

PARTS AND MATERIALS

27 COLD ROLLED SPRING STEEL — *Uddeholm Co of America, 155 E 44th St, New York 17, NY.* 43-page spring steel stock list contains illustrated general information on Swedish cold rolled steels, describing special features and principal types. Lists all standard sizes and warehouse grades. Includes conversion tables, standard gage, hardness conversion data.

28 HYDRAULIC AND PNEUMATIC CYLINDERS—*Petch Manufacturing Co, 463 York, Detroit 2, Mich.* 16-page illustrated condensus 8a covers standard and special units and related products. Describes new concept in hydraulic valve panel fabrication by building block components.

29 PRECISION BALL BEARINGS — *Messinger Bearings, Inc, 3733 D St, Philadelphia 24, Penna.* 12-page catalog 59 contains data on Featherweight line available as either radial, angular contact, or 4-point contact. Information provided on basis of load ratings and life.

30 "GRAIN SIZE THE 4TH DIMENSION OF BRASS"—*Bridgeport Brass Co, 30 Grand St, Bridgeport 2, Conn.* 6-page bulletin discusses the importance of grain size of brass alloys, explains how the selection of the correct ultra fine size can reduce finishing costs, and describes in detail how the grain sizes of brass strip is affected by annealing and cold rolling. Points out that size affects such properties as ductility, smoothness of surface on drawn parts, tensile strength, hardness and elongation.

31 ADJUSTABLE SPEED DRIVE — *Louis Allis Co, 427 E Stewart St, Milwaukee 1, Wis.* 6-page bulletin 2750 provides information on redesigned Ajusto-Spede drive in ratings of ¾ to 7½ hp, designed to operate on ac power. It is suitable for continuous operation at full load (constant torque) in ranges as high as 34:1 and for intermittent use from zero to full speed, or any rpm in between. Dimensions and engineering information included.

32 LEADED STEEL FORGINGS—*Alco Products, Inc, PO Box 1065, Schenectady, NY.* 40-page data book covers case histories, mechanical properties, and machining tests of Hi-Qua-Led additive steel forgings said to reduce machine time more than 50% and increase tool life up to 100 times. Forgings are available in circular forged and rolled shapes from 18 to 160 in. OD, in open-die shapes from 1000 to 36,000 lbs, and in mandrelled ring forgings up to 60 in. wide.

33 SPROCKETS—*Acme Chain Corp, 821 Main St, Holyoke, Mass.* 20-page illustrated catalog 100B contains a complete listing of Grip-Master stock sprockets and flexible couplings for roller chains. Includes

"Deliver me from these geniuses—just give me some dope who knows what he's doing!"

New:

Hanson-Whitney's new production techniques give you *consistent* quality cutting edges with *"free-cutting action"* for increased productivity. These advances in Hanson-Whitney standard cutting tools mean longer tool life—uniform size and less binding. And you protect your threading investment from start to finish, with Hanson-Whitney's *related* line of standard Thread Gages—keeps your profit dollars up, where they ought to be.

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CIRCLE 325 READER SERVICE CARD

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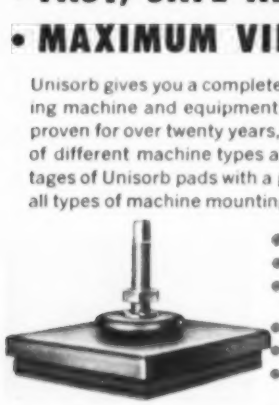
- **FAST, SAFE AND SIMPLE INSTALLATION**
- **MAXIMUM VIBRATION CONTROL**

Unisorb gives you a complete line of vibration control machine mounts for simplifying machine and equipment installation everywhere in your plant. Unisorb pads, proven for over twenty years, are engineered to handle the "vibration personality" of different machine types and loadings. Unisorb Level-Rite combines the advantages of Unisorb pads with a precise, efficient leveling device that greatly simplifies all types of machine mounting. See how these features can help you in your plant.



- Absorbs up to 85% of transmitted vibration
- Eliminates bolts and lag screws, no floor damage
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FEB-44

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dimensions, prices, mounting and dismounting intructions, other engineering data.

34 BEARING UNITS—*Browning Manufacturing Co, Maysville, Ky.* 15-page illustrated catalog BU-101-B containing information on pillow blocks, flange blocks, and ball bearings, includes data on new line of take-up units which combine the advantages of antifriction bearings with company's unbreakable malleable housing, and welded steel frames with cadmium-plated adjusting screws. Construction details dimensional tables, and listing of stock sizes are included in the catalog.

35 LIGHTWEIGHT 220,000-PSI LOCKNUT—*Standard Pressed Steel Co, Box 875, Jenkintown, Penna.* 4-page illustrated bulletin (Form 2487) presents data on FN 22 series designed for use at temperatures to 550 degrees. Featherweight locknuts are said to combine exceptional strength-to-weight ratio with superior fatigue characteristics and high re-usability. Includes specifications, size ranges, performance characteristics, and ordering information.

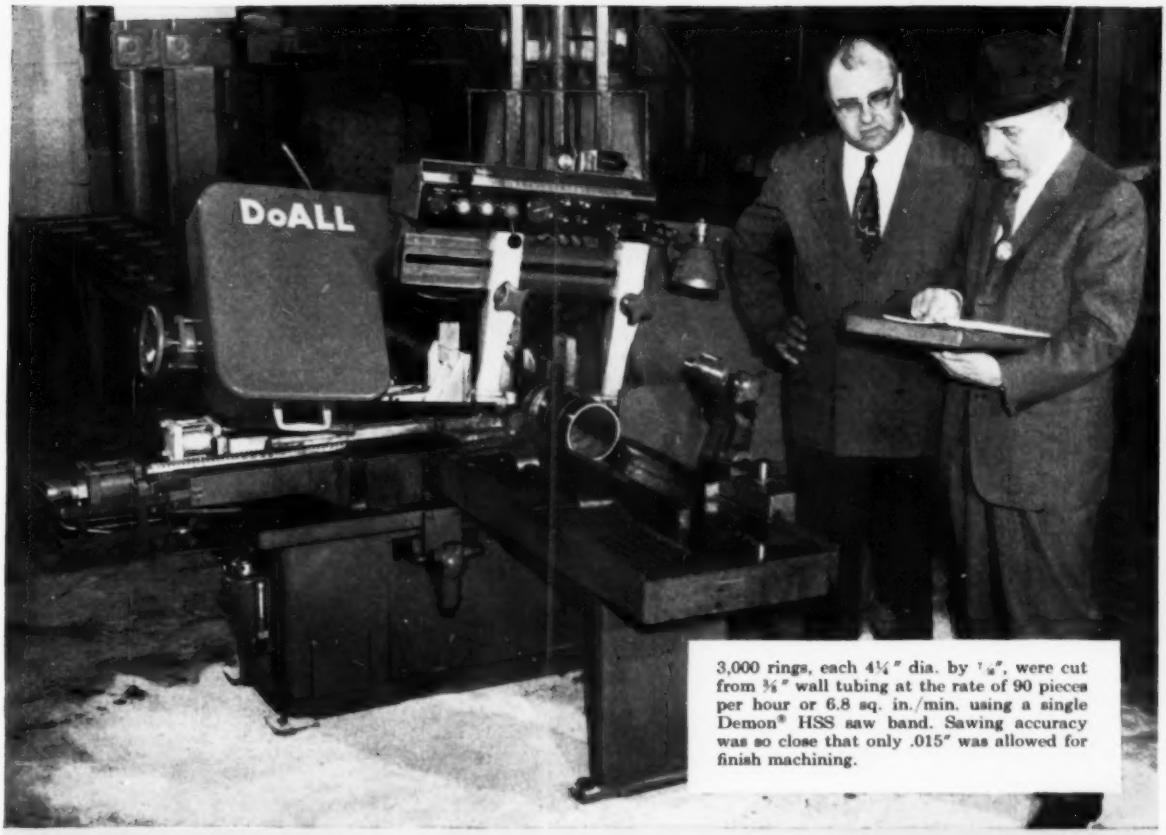
36 SELSYN SYSTEMS—*General Electric Co, Schenectady 5, NY.* 6-page illustrated bulletin GEC-1527 describes in detail selsyn motors and generators and selsyn indicators for wide variety of applications. Operation, applications, ordering instructions are included together with selection and mounting charts, torque-resistance curves, dimension charts and drawings.

37 RUBBER SEALS—*Minnesota Rubber Co, 3630 Wooddale Ave, Minneapolis 16, Minn.* 24-page Fact Book has been expanded to include installation data, and compound information. Includes size numbers and dimensions of all common industrial O-rings and the Quad Ring; reference charts covering Aeronautical Material Specifications, SAE-ASTM material specifications, MIL-R-6847C specifications, UL-approved rubber compounds, information about media in which various compounds can be used. Final section of the book is devoted to description of the Kapseal, with size charts and installation guides.

38 SERVOVALVES — *Moog Valves Co, East Aurora, NY.* 6½-page catalog 150 describes operating principles, design features, performance characteristics of line of pressure control servovalves effective

EPEX MACHINE

"You can't help admiring the boss—if you don't, he fires you."



3,000 rings, each 4¼" dia. by ⅛", were cut from ¾" wall tubing at the rate of 90 pieces per hour or 6.8 sq. in./min. using a single Demon® HSS saw band. Sawing accuracy was so close that only .015" was allowed for finish machining.

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CALL YOUR DoALL SAWING SPECIALIST

Your band sawing costs can be materially reduced when both machine and blade work together as a team. Because only DoALL makes both machines and blades, only your DoALL Sawing Specialist can match them for top efficiency. Here's a typical case:

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There's a complete sawing service near you. It's your local DoALL Sales-Service Store, which has everything you need to help you get more for your band-sawing dollar. Its expert help is *free*, so call today or write—

SB-67

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That's why so many users continue to rely on Oakite to reduce their "per unit" cost. They know that year after year, they are getting the best cleaning for the lowest possible cost.

OAKITE
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years' leadership in industrial cleaning

Oakite's pioneering in the future will mean what it has meant for the past 50 years: not only better products, but better service . . . better methods . . . better equipment. All deliberately designed with you in mind to give you the most for your cleaning dollar.

This handy guide is a distillation of 50 years of Oakite cleaning experience. It can save you valuable time—and cold cash, too—on all your cleaning operations. Send for it. Oakite Products, Inc., 50A Rector Street, New York 6, N. Y.

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in closed-loop systems to control load acceleration; they may also be used directly as force transducers or pressure regulators. Typical applications include aircraft and missile control systems and industrial installations for automatic machine tools and testing machines. Includes glossary of pressure control servovalve terminology and gives specific data on valve droop and its relationship to valve design.

39 ROTARY SWITCH — *Chicago Dynamic Industries, Inc, Precision Products Division, 1725 Diversey Blvd, Chicago 14, Ill.* 4-page illustrated brochure describes rotary switch with wafers which lift out instantly without unsoldering or disassembling for fast, easy cleaning or replacement.

40 POWDER METAL BEARING — *Chrysler Corp, Amplex Div, PO Box 2718, Detroit 31, Mich.* 4-page illustrated brochure illustrates and describes new self-lubricating Iron Oilite 212 bearings suitable for many bronze applications where corrosion is not a problem and mechanical strength is within tolerable limits. Complete performance data, properties, recommended uses and applications included.

41 SUPER PURE CHROMIUM—*Chromalloy Corp, 450 Tarrytown Rd, White Plains, NY.* 4-page bulletin 30 gives data on Iochrome, a new 99.997% pure chomium metal said to contain no single metallic or gaseous impurity in quantities greater than 10 parts per million. Users report a high degree of ductility in comparison with other chromium now available. Includes suggested applications, typical analysis, and photos showing fracture and fabricability characteristics.

42 VALVES—*Koehler Aircraft Products Co, 409 Leo St, Dayton, Ohio.* 12-page bulletin C-591 illustrates and describes valves, strainers, filters, accumulators, and related products for aircraft, missile, and industrial applications. Valves are divided into five design groups with applications, functions, specifications, and operating characteristics of each type given as range figures.

"Completely automatic electronically controlled production line—to turn out wind-up clocks! !"

LINDE's NEW PLASMARC TORCH SERVICE

Brings Industry Production Parts From Refractory Metals

No other method of fabricating refractory metals can match this. . . . The high melting points of tungsten, tantalum, and molybdenum are no longer a problem. For LINDE's new *PLASMARC* Torch, working in the temperature range between 15,000 and 30,000 degrees K., can coat parts or form shapes of virtually any size or complexity. It's an entirely new way to make such articles as rocket nozzles, crucibles, components for electronic and X-ray use, and parts for atomic energy equipment!

The quality of these pieces is uniformly high. Tolerances can be held to ±.002 in. or better. The metal loses none of its purity and superior density is achieved.

With the *PLASMARC* Torch, LINDE is equipped to supply you with parts made of, or coated with, refractory metals, or made of a variety of metals combined with non-metals or reinforced plastics. LINDE will also provide a wind-tunnel materials testing service based on this device. For information on this extension of LINDE's well-known Flame-Plating service, write Dept. AW-13, LINDE COMPANY, Division of Union Carbide Corporation, 30 East 42nd Street, New York 17, N.Y. In Canada: Linde Company, Division of Union Carbide Canada Limited.

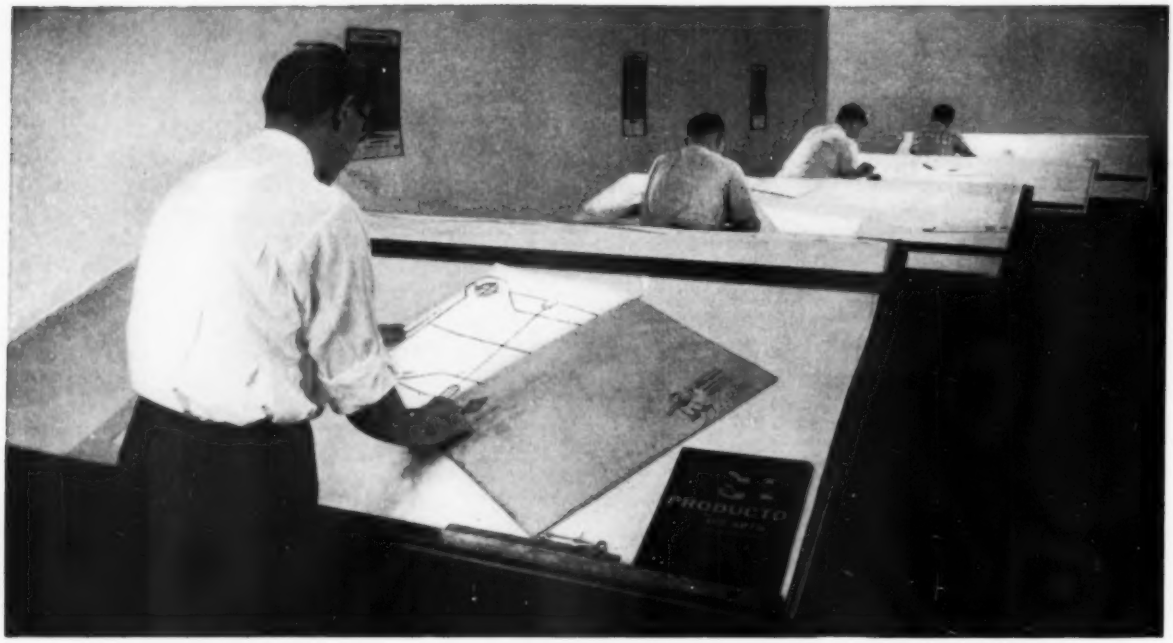
The *PLASMARC* Torch employs a non-transferred electric arc to generate such high temperatures that powder or wire fed into the chamber is literally melted. Inert gases flowing continuously carry the metal particles in a plastic state and deposit them on the workpiece at near-sonic speeds. Jets of CO_2 cool the particles instantly to form heat- and erosion-resistant material. Coatings—even on graphite—have an excellent bond. Shapes are built up on machined mandrels, which are then etched away to leave parts such as those shown above.

Linde TRADE MARK

UNION CARBIDE

"Linde", "Union Carbide" and "Plasmarc" are trade marks of Union Carbide Corporation.

Why the Die Designer Prefers PRODUCTO Die Sets



He can specify Producto with complete confidence

The die designer likes to specify Producto die sets on his blueprints because they are a nationally-accepted "brand." They're easy to get anywhere... and delivery is prompt.

He favors Producto because he knows he never has to compromise his die design. Even if the die layout is a little unusual, he will be able to select a die set to accommodate it from Producto's wide range of thicknesses and styles.

He also knows Producto has the equipment that can cut his tooling costs by letting him adapt his sets to a more economical *basic* design. Only Producto offers him complete foundry, pattern-making, welding and machining services for his special requirements.

The die designer recognizes Producto's Qwik-Fit Guide Pins as an important new feature that die makers want. He specifies them because they save up to 75% of the time normally required for die set assembly and disassembly.

The die designer likes to use Producto's new catalog, the industry's most practical tool. His die layout is simplified when he uses Producto die set templates. And Producto provides him with cost-saving ideas in the DIE SET DIGEST.

Most important, he can depend on *consistent* Producto die set accuracy to transfer from the drawing board to the press the precision and ingenuity of his die design.

Yes, the designer has found that Producto die sets justify his confidence in specifying Producto. You will, too.

TWO FREE AIDS to more economical, efficient use of die sets are available from Producto. All-new CATALOG NO. 11 makes ordering and selection job easy. DIE SET DIGEST gives valuable tips for designers, builders and users of dies. Write for them today.

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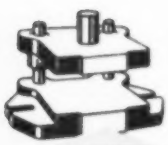


Wherever die sets are used

PRODUCTO

PRODUCE MORE WITH PRODUCTO PRECISION DIE SETS

John J Hayes has been elected president of Morse Twist Drill & Machine Co, New Bedford, Mass, division of Van Norman Industries. He succeeds Charles F Myers, now president of Van Norman. Mr Hayes was formerly executive vice president and general manager of the Morse Division

Roy K Kraebber has been named plant manager of Chrysler's Amplex Division. He was previously manufacturing manager at the Lynch Road Gear and Axle plant

Robert M Miller has been appointed vice president and general sales manager, Onsrud Machine Works, Niles, Ill

NAMES IN THE NEWS...

Lester M Cole, general sales manager of Warner & Swasey Co, Cleveland, has been elected vice president, sales. Mr Cole will direct all sales activities of the Machine Tool Division, as well as those of the company's textile machinery and earthmoving equipment divisions.

Harry L Huntsinger has been appointed executive vice president of Potter & Brumfield, Inc, Princeton, Ind, subsidiary of American Machine & Foundry Co. He was formerly assistant general manager of RBM Division, Essex Wire Corp, Logansport, Ind.

Asa Snyder has been appointed director of research and development at Clearing Division of US Industries.

Jerry S Tipton has been named Multipress product manager, Denison Engineering Division of American Brake Shoe Co, Columbus, Ohio. As a member of the sales department he has been working with applications of the Multipress to mass production since 1955.

Adolph A Karrasch, assistant works manager of International Harvester Co's motor truck plant at Fort Wayne, Ind, has joined Hercules Motors Corp, Canton, Ohio, as director of manufacturing.

James A Taylor has been elected president of Standard Screw Co, Bellwood, Ill. Previously vice president, he succeeds **W D Corlett,** named board chairman.

Lee S Johnson (left), vice president, United Aircraft Corp, and general manager of Sikorsky Aircraft Division, has been elected a member of the board of the Bullard Co, Bridgeport, Conn. **Paul L Smith,** formerly controller, has been elected treasurer, succeeding **Francis L Dabney,** now vice president and secretary

George H Sanborn, general sales manager of Fellows Gear Shaper Co, and **Stewart Barton,** assistant general sales manager, have transferred their headquarters from Detroit to the main plant in Springfield, Vt. Branch office in Detroit will continue with **A R Tobin** as manager.

Charles W Wesson has been elected president of Eastern Machine Screw Corp, New Haven, Conn. **Carl W Bettcher,** former president, has been named board chairman.

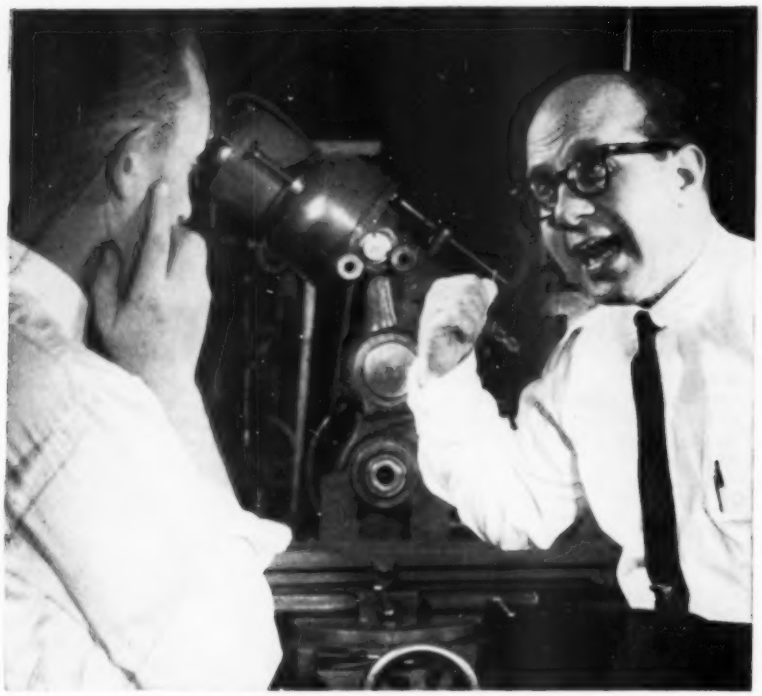
Ralph G Caouette has been appointed general manager of the automotive section of the Bendix Products Division at South Bend, Ind. He was formerly assistant general manager of the automotive products section.

E D White has been named vice president and general manager of the Union Die Casting Co, Whittier, Calif. He has been associated with the firm since 1954.

Jack L Kennedy has been appointed chief sales engineer for the Press Division of E W Bliss Co. Mr Kennedy has been sales engineer in the Canton, Ohio, general office for the past eight years. He will take over the duties formerly held by **Harold B Morse,** who has retired.

Allan Ray Putnam has been named managing director of the American Society for Metals, a new position established by the ASM board of trustees following the death last May of William H Eisenman, a founder-member of the Society and national secretary and executive head for 40 years. Mr Putnam comes to ASM

TORIT DUST COLLECTION ENDS THIS:



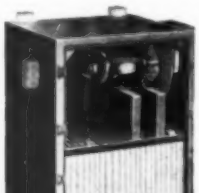
"OUT OF PRODUCTION FOR THREE DAYS? THAT'S WHEN WE'RE SUPPOSED TO SHIP!"

"And believe me, that wasn't all the boss said! Two key machines were so clogged with dirt and grime we had to disassemble and clean them—overnight! Between overtime for the repair crew and our own crew, I managed a partial shipment in three days. And I made up my mind this wasn't going to happen again!

"I'd heard of preventive maintenance with Torit Dust Control equipment—and the Torit representative I called sure opened my eyes! Clean machines hold close tolerances better and up to 80% longer! Torit collectors remove over 99% of dust and air-borne debris, save on both the cost and frequency of servicing.

"I expected there'd be a hitch on prices—but look what I found out: our production breakdown cost nearly as much as the Torit equipment we needed! And just while Torit Dust Collectors are being depreciated we'll make money on them—through maintenance savings, improved production, and reduced down-time!

"The boss actually congratulated me when I showed him the savings Torit preventive maintenance gives us!"



Torit Dust Collectors stop dust build-up before it costs you money. They're available in both high efficiency cyclone and cabinet type units. Why not check into them today—write:

TORIT manufacturing company

Walnut & Exchange Streets, St. Paul 2, Minn. Dept. 420.

NAMES IN THE NEWS...

from Detroit where he is assistant executive secretary of the American Society of Tool Engineers.

E C Shawe has been named production manager of Chrysler's Dodge Assembly Plant. He was formerly plant quality control manager

J A Cappi has been named assistant to the vice president of Electric Auto-Lite's Electrical Products Group, Toledo, Ohio. Mr Cappi, a vice president of Auto-Lite, has headed the Champlain Street plants in Toledo. **R C Roderick** has been named to the newly created post of Toledo Division manager. He was formerly general manager of the Fort Wayne, Ind, plant of Fruehauf Trailer Co.

Sy Dworecki, Chicago district manager for Wesson Co, Detroit, has been elected a vice president of the company. Also named vice presidents: **James J Smith, Jr,** district manager, East Paterson, NJ; and **Gerald Bogner,** district manager at Cleveland.

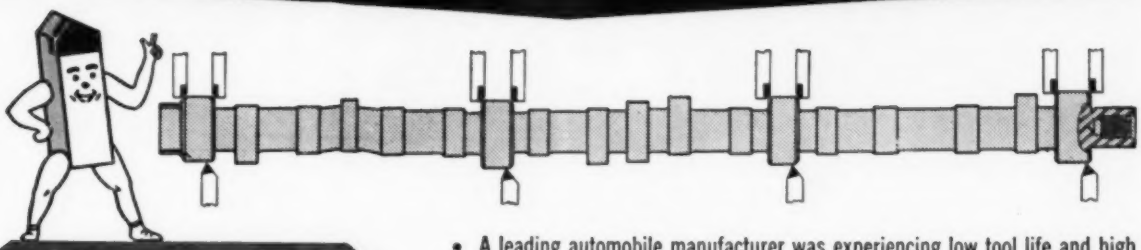
B R Teree has been appointed vice president, engineering, of Republic Manufacturing Co, Cleveland maker of pneumatic and hydraulic valves and special accessories. He was formerly vice president, engineering and manufacturing, of Greer Hydraulics, Inc, Jamaica, NY.

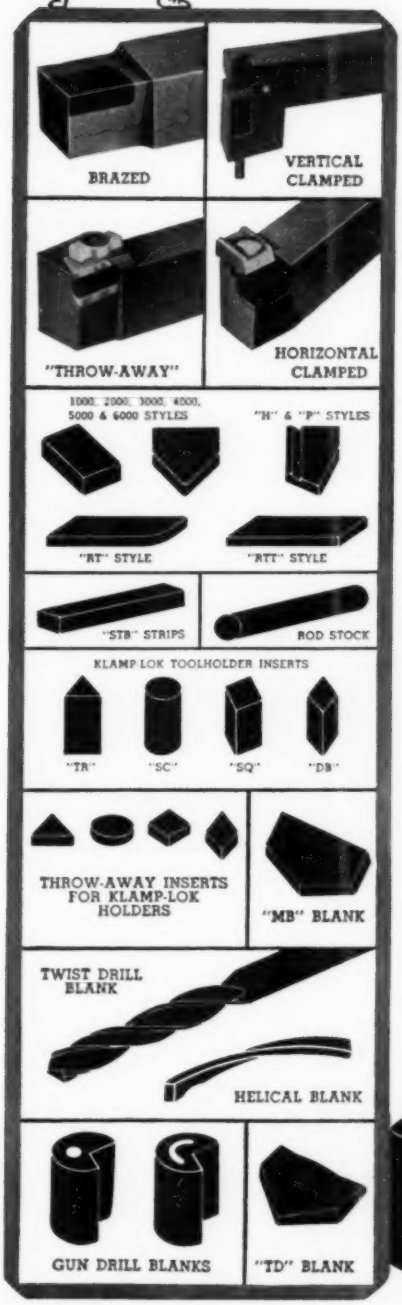
Herman R Brown has been appointed sales manager of the Payloader Division of the Frank G Hough Co, Libertyville, Ill. He was previously western regional manager.

Warren G Bruns has been named district manager of the St Louis office of Pratt & Whitney Co. Formerly sales representative, he, he succeeds the late **O B Sondag.**

(Continued on p 233)

1020 CAMSHAFTS MACHINED WITH Talide® C-91!





• A leading automobile manufacturer was experiencing low tool life and high costs machining camshafts made of tough, highly abrasive ArmsSteel. Talide tool engineers installed Grade C-91 with the following superior results:

GRADE C-91 CASE HISTORY

Part..... Automobile camshaft

Material....ArmsSteel 1.8165 dia. x 23-½" long, 32 Rc hardness

Operation.. Rough turning 4 bearing surfaces

Machine....Sundstrand Model #8 automatic

Tools.....4 Talide TB-123 ⅜" I.C. x 1-½" long triangular inserts, Grade C-91, mounted in Klamp-Lok toolholders

Depth of Cut..1/16" to 3/32"

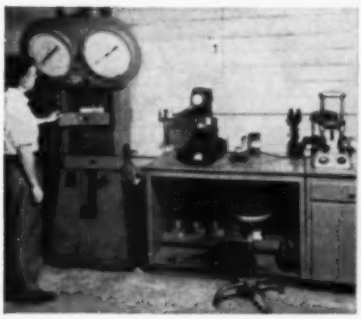
Feed.....012

Speed.....130 (S.F.M.) 274 (R.P.M.)

Coolant.....Soluble Oil

Results....Talide Grade C-91 machined 1020 camshafts per grind compared to 550 for 2nd best competitive grade and 275 for 3rd best. Special attention to the grind and chip breaker detail resulted in Grade C-91 outperforming all other grades used previously.

QUALITY CONTROL GUARANTEES TOP TOOL PERFORMANCE . . .



Determining rupture strength of test bar. Hardness is determined on Rockwell machine, center.

Leco and Burrell instruments are employed in the analysis of metal oxides.

• A constant research program at Metal Carbides pays off in improved Talide grades having extra high hardness, strength, rupture resistance and crater resistance properties. Processed in latest type vacuum electric furnaces—all Talide grades are uniform and consistent in quality.

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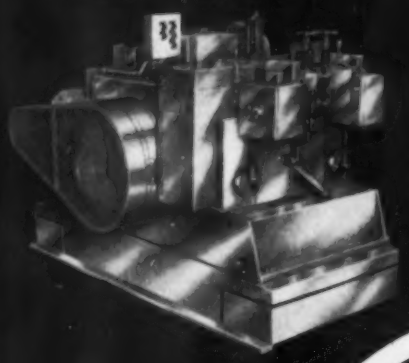
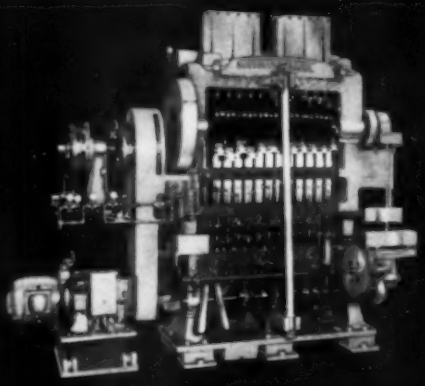
TALIDE®
YOUNGSTOWN 12, OHIO

Metal Carbides Corporation Youngstown 12, Ohio

HOT PRESSED AND SINTERED CARBIDES • VACUUM METALS
HEAVY METAL • ALUMINUM OXIDE • HI-TEMP. ALLOYS
OVER 25 YEARS' EXPERIENCE IN TUNGSTEN CARBIDE METALLURGY

COLD HEADING MACHINERY





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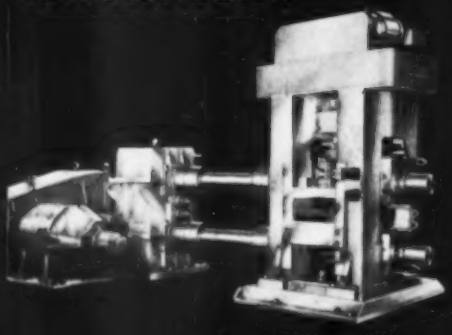
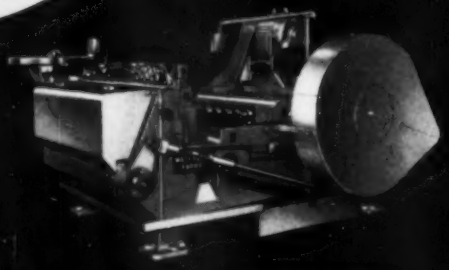
WATERBURY FARREL

MACHINERY BUILDERS

ROLLING MILL MACHINERY





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DIVISION OF TEXTRON INC.

Waterbury, Connecticut • U.S.A.

Sales Offices: Chicago • Cleveland • Los Angeles • Millburn, N. J.

WF-59

NAMES IN THE NEWS...

Harry Tiffany has been appointed head of special products for Sahlin Engineering Co, Birmingham, Mich, manufacturer of Iron Hand press unloaders and pressroom automation equipment. He was until recently vice president and general manager of Michigan Production Engineering Co, maker of special automation equipment.

Paul V Brown has been appointed manager, manufacturing, of La Verne, Calif, plant of Taylor Fibre Co, Norristown, Penna. Plant makes industrial high pressure laminated plastics. Mr Brown was formerly technical director of Fabricon Products, Los Angeles.

Harold F Schulte has been named chief engineer of Wheelabrator Corp, Mishawaka, Ind. He has been acting chief engineer for the past year.

Hardwick L Browne has been named sales manager, Welding Products, International Division of the Harnischfeger Corp of Milwaukee.

Ralph Cutler has been named a vice president of Yuba Consolidated Industries, San Francisco, and general manager of Southwest Welding and Manufacturing Division. He was formerly associated with Kaiser Steel Corp, Montebello, Calif, as manager of engineering for the fabricating division. **Monte Lindmoe,** formerly executive vice president of Southwest Welding, has been appointed vice president of Yuba and director of sales for all of the operating divisions and subsidiaries.

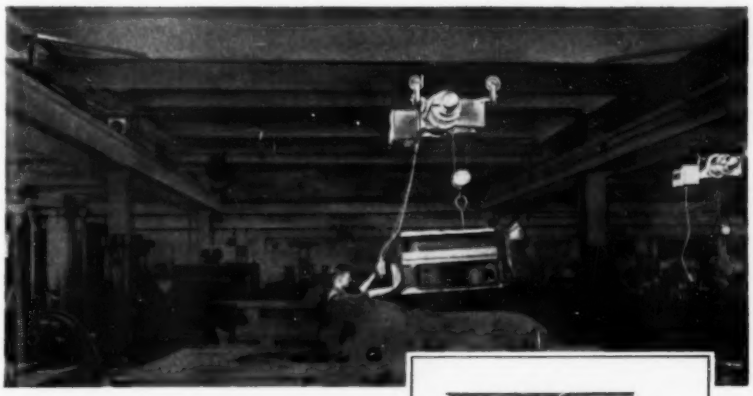
C W Trautman has been appointed manufacturing manager of the George L Nankervis Co, a subsidiary of Peninsular Metal Products Corp. He was formerly manager of test equipment engineering for Bendix Products Division in South Bend, Ind.

James C Smith, Jr, has been appointed executive engineer of the Advanced Projects Organization, Chrysler Corp Defense Group. He was formerly chief project engineer at Chrysler's Missile Division. Additional appointments: **Charles W Williams,** manager of manufacturing at the Missile Div, to director of manufacturing operations, APO; **John M Martin,** manager of Missile's Jupiter Engineering Project Staff, to director

SHEPARD NILES HOISTS

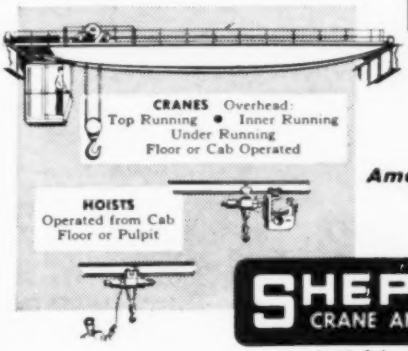
LIFT LOADS

long after they're written off



LOOK FOR YEARS of dependable, trouble-free lifting when you invest in a Shepard Niles Hoist. Because Shepard Niles builds hoists that go on lifting long after you've written their original cost off. This is the kind of performance you expect and get with a Shepard Niles Hoist.

Investigate the complete line of Shepard Niles Hoists . . . choose from medium and heavy capacities with slow, medium or fast speeds. Built for cycle duty, heavy intermittent duty, medium duty and light-occasional service. Short to long lifts, standard or close headroom, manual or magnetic controls.



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NAMES IN THE NEWS...

of plans and programs, APO; **Robert C Terbeck,** Missile's assistant chief engineer for field support, to APO director of field operations.

Harry F Rose has been promoted to manager of crane and monorail sales for Yale & Towne Manufacturing Co's Materials Handling Division. He was formerly regional sales manager on the West Coast.

Charles O Dahl has been appointed general manager of the Landers of Arkansas division of Landers, Frary & Clark, New Britain, Conn, manufacturers of electric housewares products.

John V Banks has been appointed assistant general manager of the Montebello fabricating division plant of Kaiser Steel Corp. He was previously production manager.

Randolph W Cornes has been appointed assistant to the sales manager of Sperry Gyroscope Co's Electronic Tube Division. He was previously assistant sales manager for Microwave Electronics.

Savin Zavarella, president of Pressure Blast Manufacturing Co, Manchester, Conn, has taken on the duties of general sales manager.

Arthur J R Schneider, chief research engineer, has been promoted to chief engineer of the Technical Products Division of Waste King Corp, Los Angeles.

J Harry Reed has been promoted from sales manager to vice president, sales, of Youngstown Foundry & Machine Co, Youngstown, Ohio.

John T Schaner has been appointed purchasing agent of J H Williams & Co, Buffalo manufacturer of wrenches, tools, and drop forgings. Formerly assistant purchasing agent, he succeeds the late **J P O'Brien.**

R David Mathias has been named vice president, sales, of L & J Press Corp, Elkhart, Ind, manufacturer of punchpresses. **Robert H Kemp** has been appointed chief engineer.

OBITUARY

Eugene E Maurey, Sr, 76, president and founder of Maurey Manufacturing Corp, Chicago, died in Miami March 18.

NEW BOOKS...

THE GRINDING WHEEL, 1959—*Revised by William F Schleicher. Published by the Grinding Wheel Institute, 2130 Keith Bldg, Cleveland 15, Ohio. 32 chapters. 532 pages. Price $4.95*

This thoroughly revised and updated edition discusses grinding wheels, grinding machines and grinding operations from a basic, as well as a practical, working standpoint.

Opening chapters discuss abrasive materials, wheel shapes and sizes, bonds and wheel manufacture. Succeeding chapters discuss all major grinding operations: centerless, cylindrical, rough, roll, surface, etc. In addition, special chapters deal with evaluation of surface quality, truing and dressing, grinding fluids, and factors affecting wheel selection. The practical aspect has been stressed throughout the book.

The current, revised edition is based on the 1951 edition, greatly expanded, and it contains over 100 pages of new material. Four new chapters have been written on mounted wheels, reinforced wheels, automation, and advanced mechanization and safety. Many new subjects are introduced, including jig grinding, electro-assist grinding, optical-projection grinding, filtering of grinding fluids, and grinding of ceramics. Noteworthy additions have been made in the chapters on: abrasive materials, disk grinding, roll grinding, costs, and evaluation of surface quality.

Several of the chapters will be especially important for the majority of readers. These include those on efficient wheel selection, the abrasive material, and the fundamentals of grinding. Here are spelled out how wheels can be selected for most efficient work, how the grinding process actually removes metal, how to select speeds and feeds, and how much material can be efficiently removed.

Sections in the book include a trouble-shooting chart and a wheel-selection chart. In the former are discussed, in eight pages, the majority of troubles which beset the grinding operator with the corresponding correction leading to the elimination of the trouble. The detailed, 16-page wheel selection chart, gives wheel recommendations for every major kind of material from agate to wrought iron. Wheel selection for zirconium, ceramics, germanium and titanium is discussed in the proper chapters.

ONLY ACOUSTICA ULTRASONIC CLEANERS HAVE MULTIPOWER!

MAJOR BREAKTHROUGH IN ULTRASONIC TECHNOLOGY!

In determining which ultrasonic cleaner to buy, remember that all ultrasonic cleaners are not alike. There is variation in uniformity of cavitation. There is variation in the transducer — and the transducer is the heart of an ultrasonic cleaner. The Multipower transducer developed by Acoustica research, multiplies the power and efficiency of ultrasonic action. Cleaning is faster, labor costs are lower.

Acoustica ultrasonic cleaners are engineered and produced to the finest standards, unequaled in quality and value. Off-the-shelf in capacities from 1 to 75 gal. or custom built to 5000 gal. Expert Acoustica engineers can help you with your cleaning problems. Send for further information.

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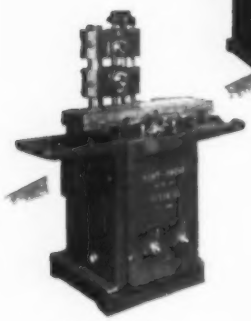
EXTRA RUGGED... SPEEDY... ACCURATE...

to Bring Down Milling Costs!

No. 1-14
32" x 9" table ... 14" table travel ... hydraulic table feed ... full automatic cycle.

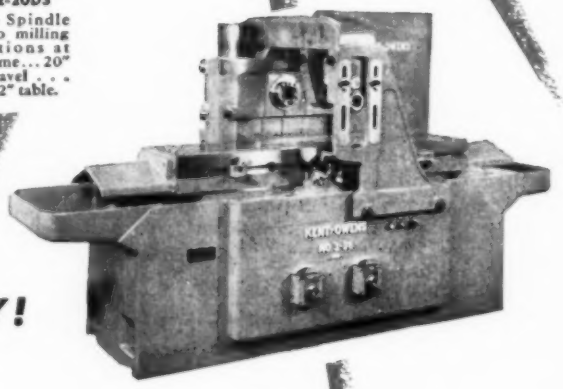
No. 2-20
20" table travel... 42" x 12" table.. fully automatic hydraulic table feed.

No. 2-20DS
Double Spindle for two milling operations at same time... 20" table travel ... 42" x 12" table.



No. 1-14DS
Double Spindle for two milling operations at same time ... 14" table travel ... 32" x 9" table.

No. 2-20V
20" table travel... vertical spindle with speed range 32 to 1284 R.P.M. ... 42" x 12" table.



No. 3-36 ... 36" table travel ... 64" x 16" table ... full automatic hydraulic feed.

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Put the work on Kent-Owens Machines for top-speed milling and topmost accuracy to keep your costs at a minimum! Advanced features throughout make the difference . . . greater dependability . . . accuracy maintained. Twin-post head mounting assures balanced load. Greater cutting efficiency—only two gear contacts, motor to spindle. Write for bulletin #757 on wide range of hydraulic and hand-operated machines. Let us quote on proper machine complete with tooling for your operation. Also, call on Kent-Owens for special machines. Kent-Owens Machine Co., Toledo, Ohio.

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for milling machines

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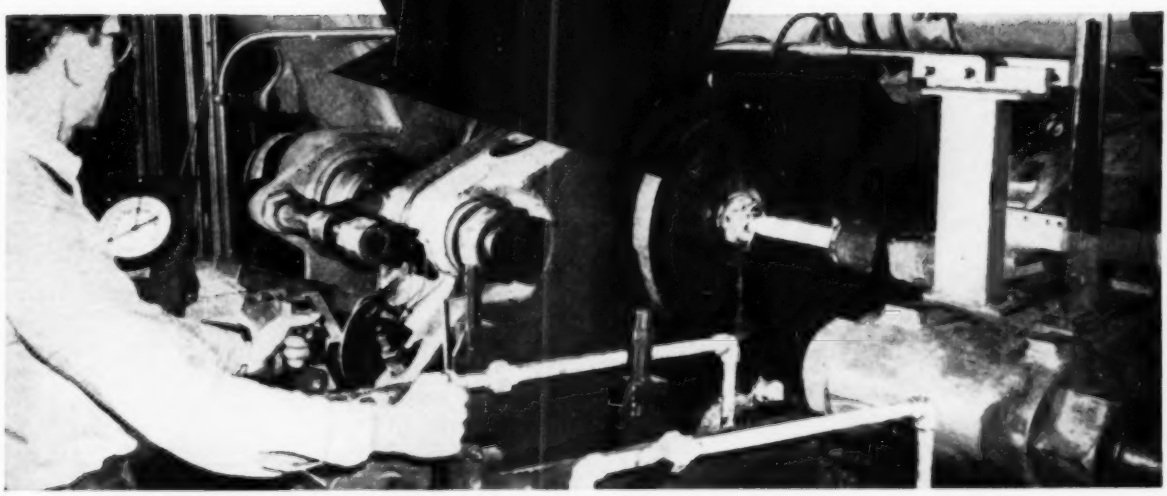
An extrusion die's performance depends on strength and toughness at its center. And the center can only have as much strength and toughness as the ingot from which it came.

That's why MEL-TROL hot work die steels, *Carpenter* No. 345 and No. 883, for instance, invariably outperform other die steels used in aluminum extrusion.

MEL-TROL is a system combining the newest and best quality controls and an exclusive new, patented ingot mold. It produces ingots that are of consistently greater uniformity and better quality through the core than any die steels yet produced by conventional methods.

Ask for *Carpenter* No. 345 and No. 883. Your *Carpenter* representative will help you select the one best for your needs from large local stocks. Place your order today.



Carpenter STEEL

The Carpenter Steel Company
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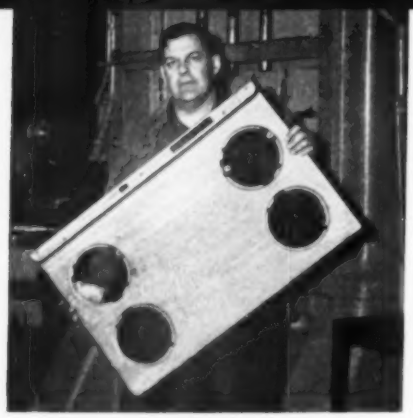
Alloy Tube Division, Union, N. J.
Webb Wire Division, New Brunswick, N. J.
Carpenter Steel of New England, Inc., Bridgeport, Conn.



Sunray pressman
displays range top that has just been blanked and formed from a quality Youngstown Porcelain Enameling Sheet.

Accent on Excellence

Youngstown cold-rolled and porcelain enameling sheets

What modern young homemaker wouldn't be in "seventh heaven" when she prepares meals in her new kitchen, accented by this modern Sunray "TOUCH OF TOMORROW" —the world's first push-button, remote control gas range.

Both Youngstown Cold-Rolled Sheets and Porcelain Enameling Sheets are the basic raw materials used by the Sunray Stove Co., of Delaware, Ohio. This is one of the prime reasons Sunray product quality is so well known throughout the highly competitive appliance field. These highly dependable Youngstown steels provide Sunray with increased production, lowered reject rates, faster and more accurate forming as well as lowered fabrication and die costs.

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Youngstown, Ohio

Manufacturers of Carbon, Alloy and Yoloy Steel

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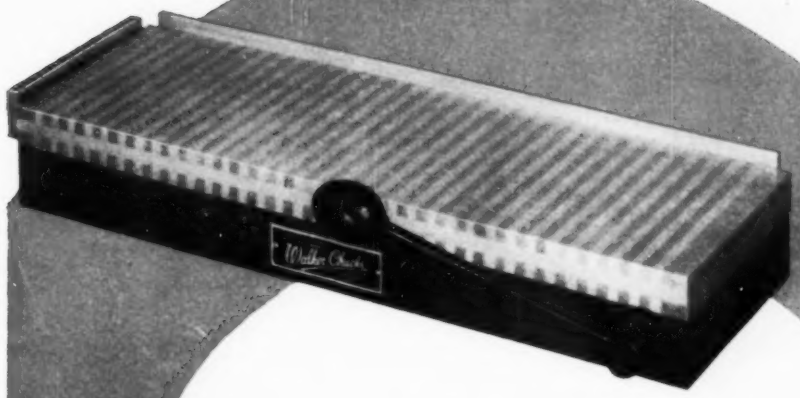

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O. S. Walker offers the world's finest chucks – both rectangular and rotary – in a full range of sizes. Their magnets are the most permanent magnets ever produced! They're ceramic, with many times the coercive force of alloy magnets. The face of every chuck is *all steel* (no soft insulating material). Other important features: 50% less weight; low, low height; fine pole divisions for maximum holding power; easy "on-off" lever, with complete demagnetization in "off" position. Write for catalog.

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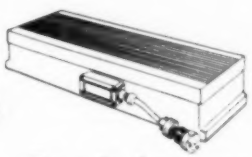
WORCESTER 6, MASS.

O. S. Walker – The Original Designers and Builders of Magnetic Chucks!

Special vacuum chucks for holding non-ferrous parts



Bar pole electro-magnetic chucks in 81 sizes

Electro-magnetic chucks in 172 sizes

Special electro and magnetic chucks and magnetic holding fixtures

Standard and special demagnetizers

1. Bronze Bearing, with self-adjusting "U" Cup Piston Rod Seal for longer wear.
2. Rod Wiper protects Piston Rod Seal and keeps Cylinder clean.
3. "U" Cup Seals expand with pressure to provide positive seal with minimum friction.
4. Wrench Flats make for easy installation.
5. Ground, hard chrome-plated Piston Rods have minimum yield strength of 125,000 psi.
6. Self-locking cushion adjusting screw and ball check are below surface for protection . . . easily accessible.
7. For extra strength, Cylinder Ends and Mounting Plates are machined from bar stock and steel forgings.
8. Cylinder is precision-finished brass for extra heavy duty.
9. Variety of mountings can be interchanged—easily match any installation requirement.
10. Interchangeable with all JIC Cylinders.

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meet and exceed JIC specs . . . 250 psi air . . . 750 psi hydraulic!

Here's compact, versatile straight-line power. Just look at the features!

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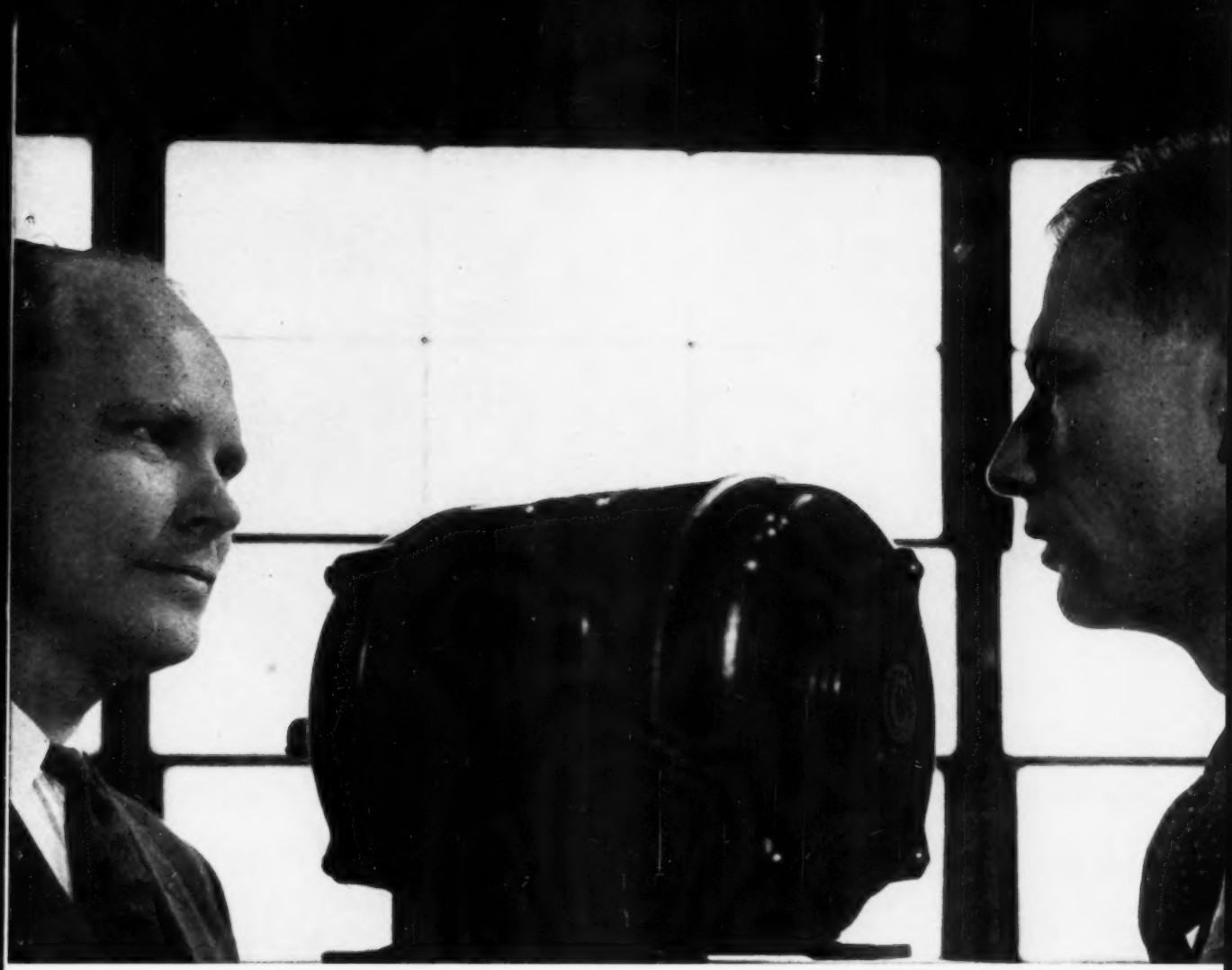

This motor can drive anything...almost

This squirrel cage, open frame, integral horsepower Century Electric motor works fine on dozens of applications. You'll find it giving dependable low-cost service on blowers, fans, pumps, lathes, drilling machines and grinders. **But . . .**

It can't do everything. There are many applications where it won't give good results. That's why you can't use just any motor on your equipment. You need the right motor. The motor that gives you the right combination of torque, horsepower, acceleration and efficiency for you to get top performance from your equipment.

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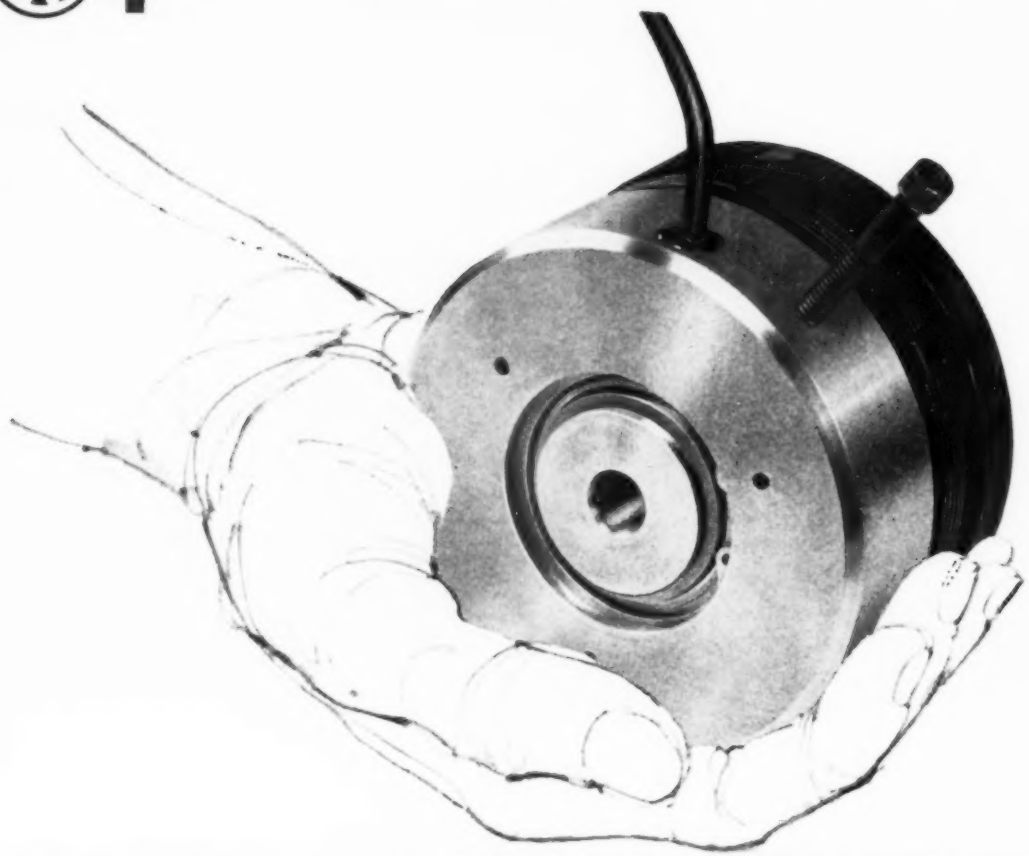
I-T-E CIRCUIT BREAKER COMPANY



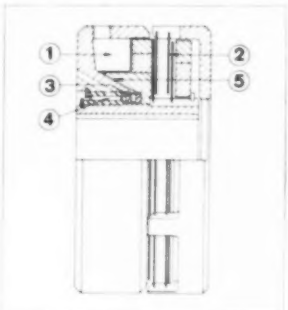
NO UPKEEP

New I-T-E Electro-Clutch with stationary field never needs maintenance of any kind!

In addition to greater compactness than any other clutch, now the I-T-E Electro-Clutch* is available with a tremendous new advantage: no upkeep. This new design has a stationary field that does away with the slipring and brush. So you are forever relieved of the problem of cleaning or replacing brushes. And of course there never was any other maintenance required . . . no air gap adjustments or friction surfaces to replace.

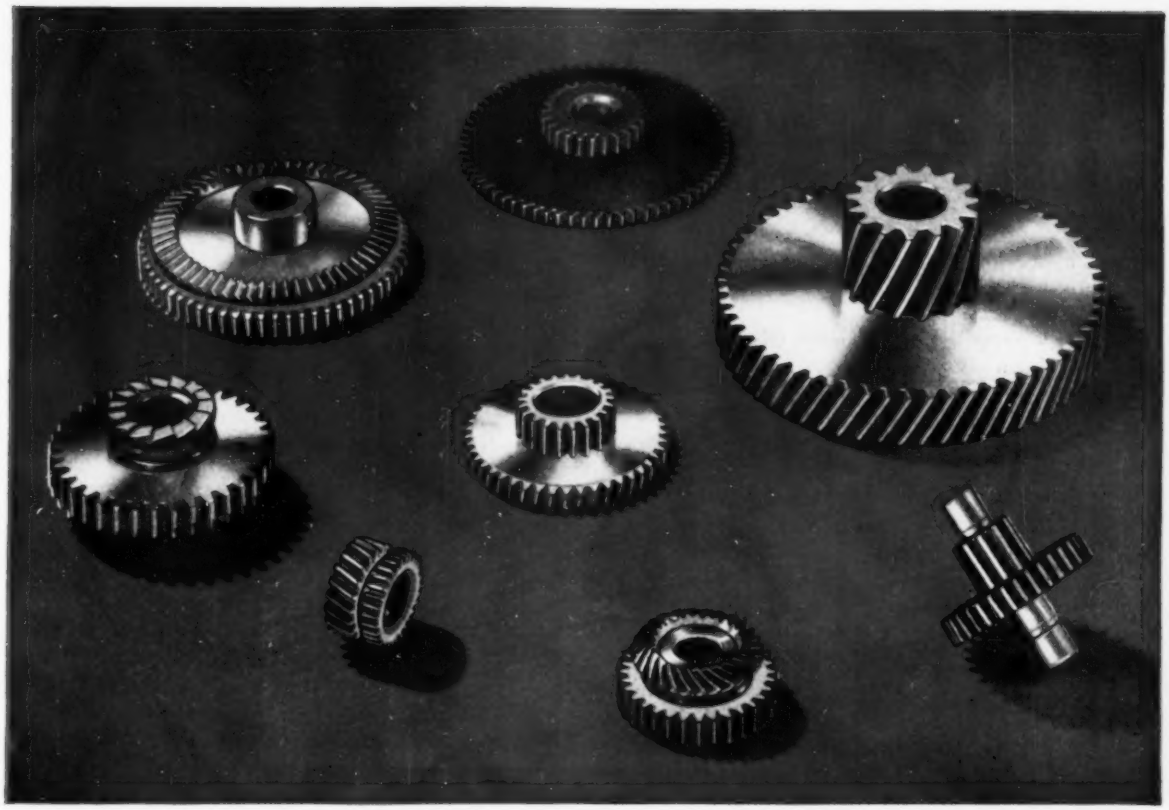
Elimination of upkeep means designers can bury the I-T-E Electro-Clutch inside a drive box or transmission . . . for access is never needed. It's a component that can be installed and practically forgotten. Roller thrust and needle radial bearings keep friction down and clutch size to a minimum . . . plus insuring long, efficient life.

Installation during machine assembly is simpler too. The clutch is delivered completely assembled. You merely slide it onto the shaft. This new I-T-E Electro-Clutch is made entirely in this country. So you are assured of availability. Same wide range of torque ratings as slipring models. Stock ratings are for 24 or 90 volts d-c. Other control voltages provided on request.



Cutaway view shows these details: (1) stationary coil windings that generate the field; (2) hardened steel clutch laminations that operate in an oily atmosphere and maintain constant torque rating without adjustments throughout life; (3) roller thrust bearings; (4) needle radial bearings; (5) air gap that never needs adjusting.

*PATENTS APPLIED FOR



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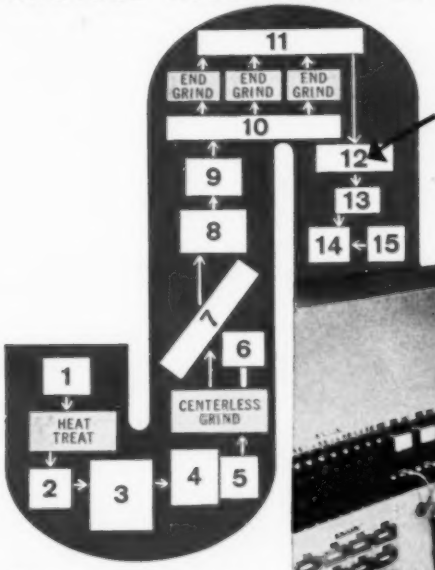
ANOTHER APPLICATION OF RCA "BUILDING BLOCK" AUTOMATION



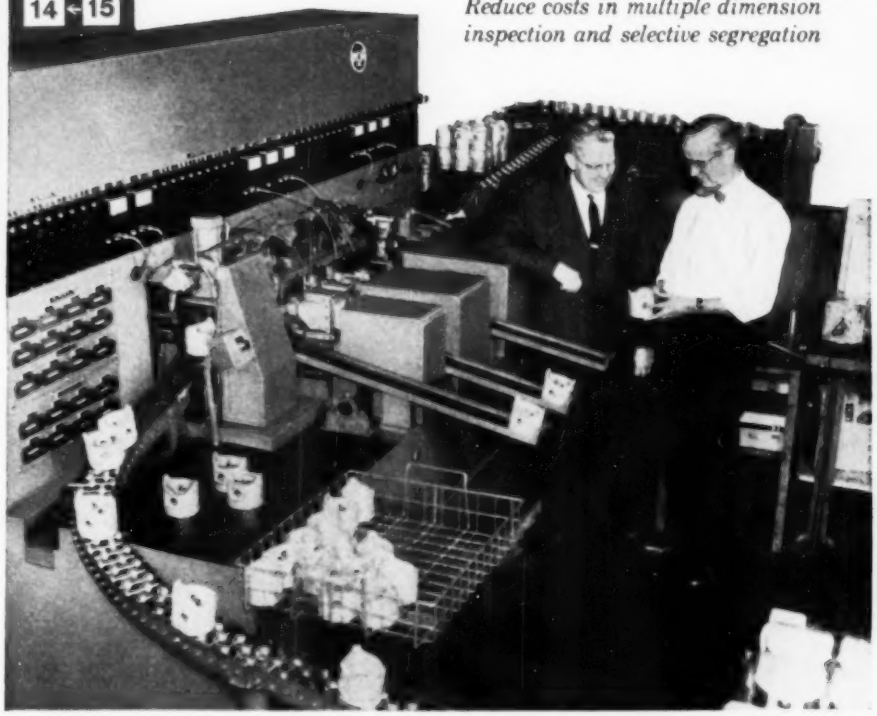
Flow diagram showing typical applications of

RCA AUTOMATION

1. RCA Floor Feeder
2. RCA Elevating Orienting Feeder
3. RCA Automatic High-Speed Hardness Testing Machine
4. RCA Floor Feeder
5. RCA Rotary Hopper
6. RCA Grinder Control
7. RCA Transfer Conveyor
8. RCA Non-Mar Feeder
9. RCA Mechanical Orienting Machine
10. RCA Demand-Feed Conveyor
11. RCA Conveyor
12. RCA Final Inspection Machine
13. RCA Non-Mar Feeder
14. RCA Automatic Assembly Machine
15. RCA Vibratory Feeder

RCA ELECTRONIC INSPECTION SYSTEMS

Reduce costs in multiple dimension inspection and selective segregation



RCA Electronic Piston Inspection Machine in operation at a major Midwestern automotive plant.

PISTON INSPECTION MACHINE
checks: OD of piston
ID of pin hole
Taper of skirt
13 segregations
count • stamp • mark

PISTON PIN INSPECTION MACHINE
checks: Length
OD runout (cloverleaf)
OD Taper
11 segregations
count

More and more of today's leading manufacturers are turning to RCA Electronic Inspection Systems to provide superior inspection reliability and accuracy.

The unit illustrated and its counterpart, the *RCA Piston Pin Inspection Machine*, provide selective segregation to assure proper fit in final assembly. The Piston Inspection Machine provides inspection to .0004" over-all tolerance, automatically classifying parts into four categories in increments of .0001". Piston Pin Inspection Machine checks OD and taper to .0004" tolerance and automatically segregates into four acceptable categories in increments of .0001". Panels give continuous presentation of entire segregating operation and show actual number of parts in each classification. These inspection machines are completely self-contained units, employing standard RCA electronic modules for flexibility in application and ease of servicing.

The diagram indicates many of the types of inspection and parts handling equipment offered by RCA for reducing costs and increasing production. For incoming inspection requirements, single gaging stations can be supplied separately. Individual gage heads and electronic modules are also available for "Do-It-Yourself" instrumentation.

For further information, write to
RCA, Dept. SD-139, 12605 Arnold Ave., Detroit 39, Michigan

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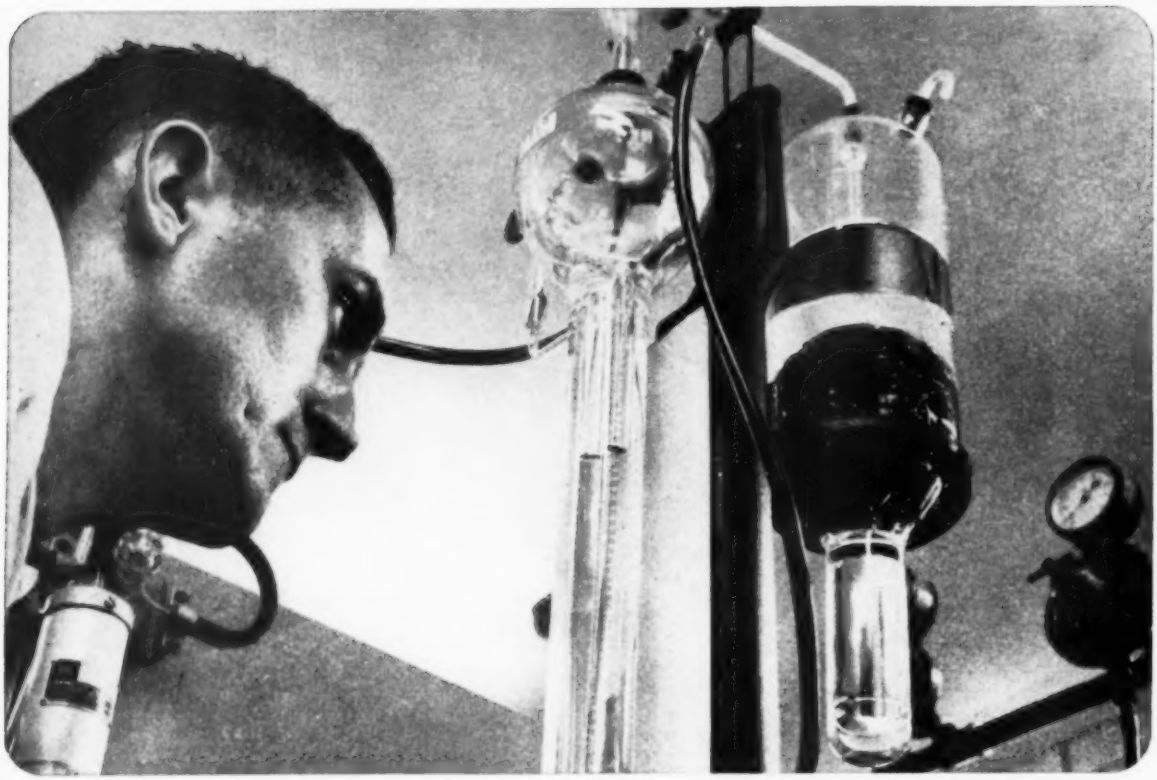

QUICK, FAST TESTING for carbon content is done not once or twice but 8 times per melt in A-L's Chem Lab with this direct reading Leco carbon determinator.

Carbon content checked 8 times during melt to guarantee A-L tool steel hardenability

Lab tests for carbon eliminate your guesswork; provide high hardness, uniform hardenability, reproducible tool performance.

Because carbon has the greatest influence on hardenability, Allegheny Ludlum watches it carefully during the melt. Testing a specimen for carbon takes only a few minutes. Therefore, A-L checks for carbon content 8 times during the melt, and makes the necessary adjustments to insure accurate control of carbon. This control means Allegheny Ludlum can hold carbon content to a closer range than most customers specify.

Carbon control at Allegheny Ludlum assures you of precise response to heat treating. This control in the melt brings you predictable, *high hardness, uniform hardenability* and *reproducible tool performance.*

This is just one of the many things A-L does to insure high quality. Here are some others: close control over forging techniques, rigid temperature-time programming, careful testing of billets prior to processing to insure good surface and sound interior, control over annealing to give you the right hardness for your exact machining operation, thorough metallurgical testing to insure top tool steel quality and meeting of your specifications.

Allegheny Ludlum stocks a complete line of tool steel sizes and grades. Call your nearest A-L representative; you'll get quick service and counsel on such problems as heat treating, machining, grade selection, etc. Or write for A-L's publication list which gives full data on the more than 125 technical publications offered. They'll make your job easier.

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Model 4F
1¾" Capacity
Spindle speeds to 2200 rpm.
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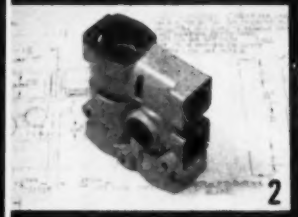
1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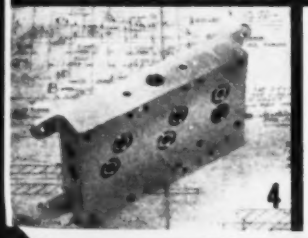
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Some of the many precision parts drilled and tapped with EDLUND Model 2F machines at Aro Equipment Corporation:

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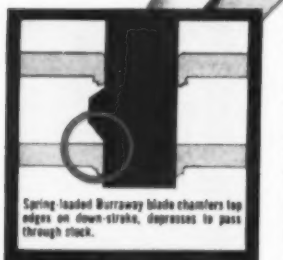

One pass of the Cogsdill Burraway tool chamfers four hole edges on this stamped handle. The job previously required four separate passes—two with a right-angle chamfer, two with a standard tool.

Burraway's spring-loaded blade adjusts for light deburring or up to ⅛" chamfer. On down-stroke, just enough pressure exerts to catch the edge; the blade then depresses to pass through the stock. On up-stroke, the under-edge is similarly chamfered.

Burraway works in any head, on automatics or multiple-spindle machines to eliminate many hand or secondary operations. Its costs are often returned the first day. If you debur or chamfer, you need Burraway.

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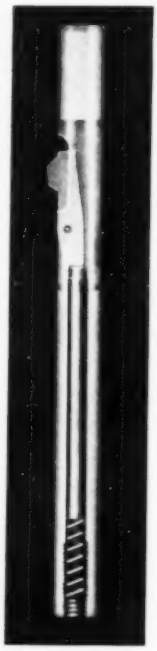

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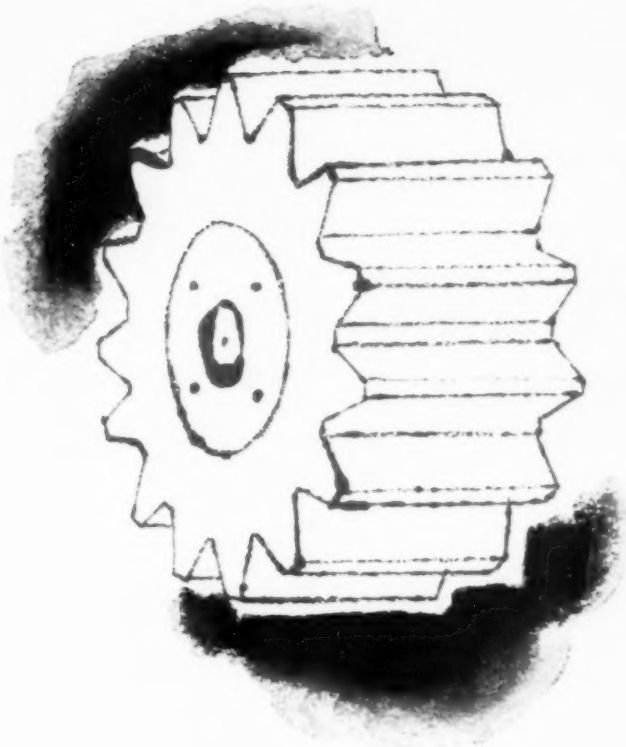

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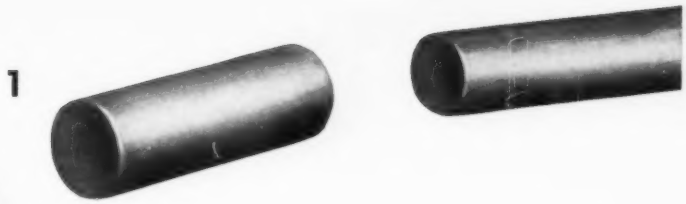

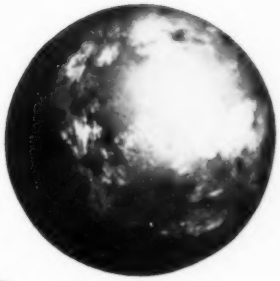

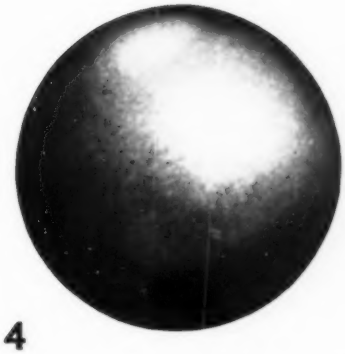

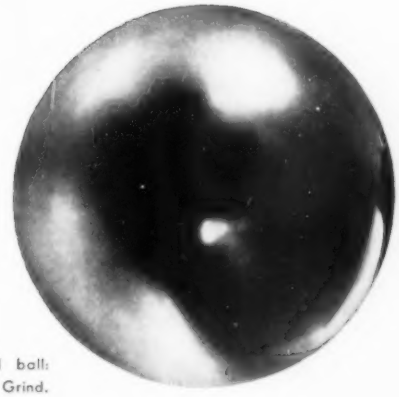

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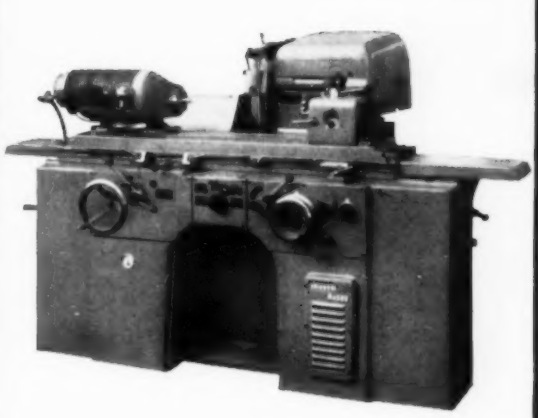

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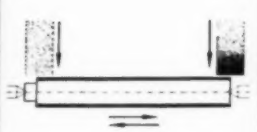

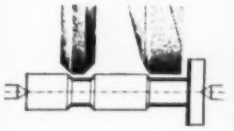

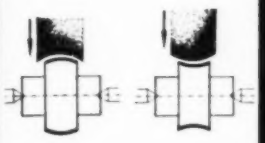

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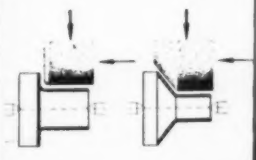

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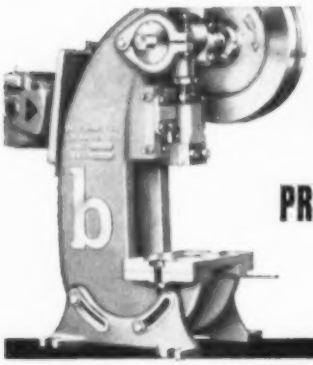

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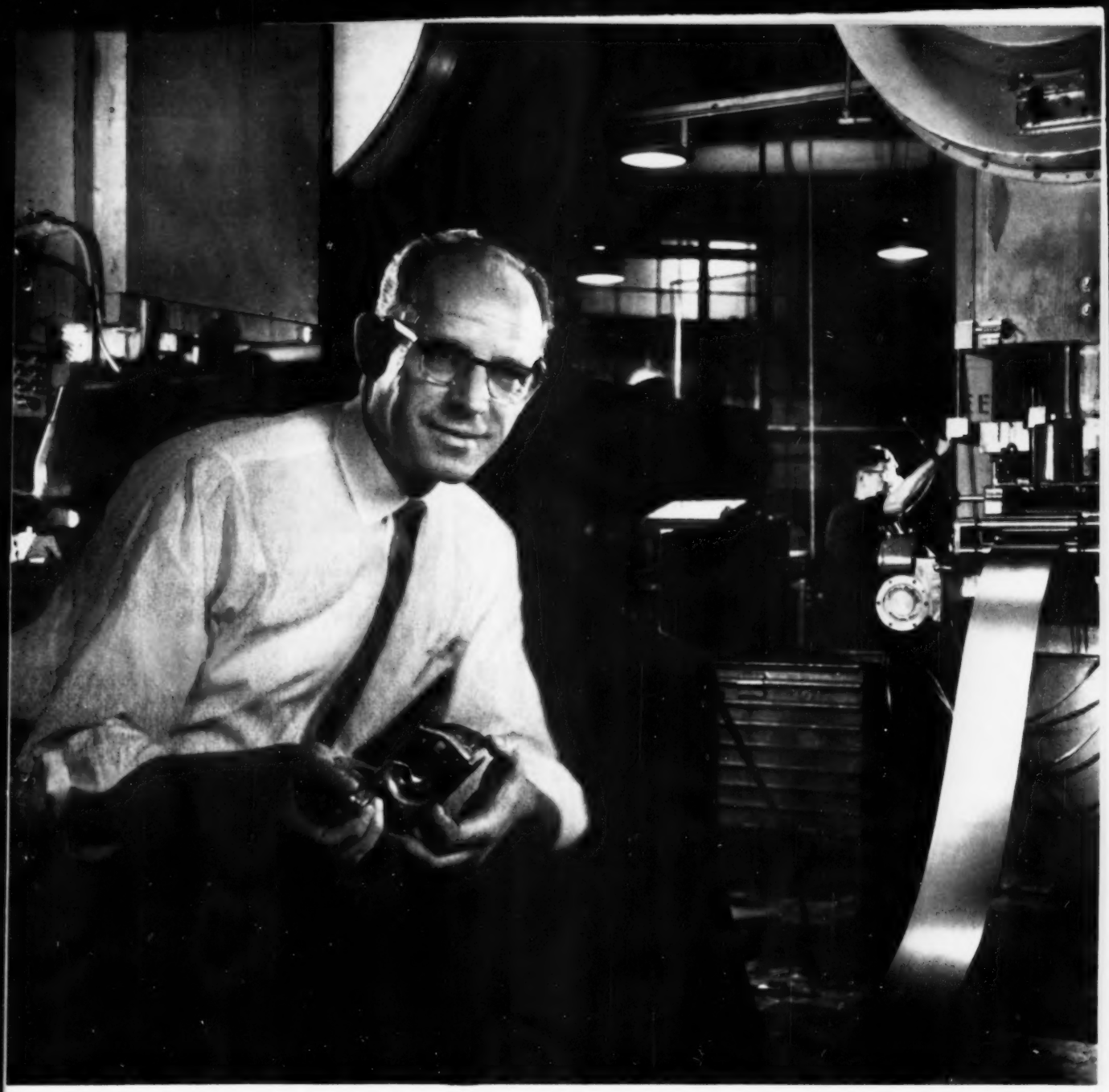

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PRECISION Quarterly NUMBER 1

PRECISION **WELDER** AND **FLEXOPRESS** CORPORATION, 3520 Ibsen, Cincinnati 9, Ohio

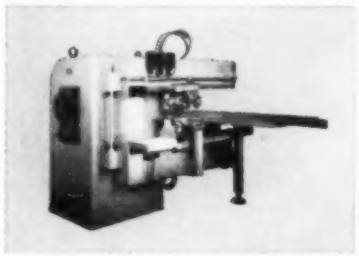
GOLDMINE IN SCRAP

Butt-seam welding process saves $70,000 in one year on one automotive stamping

EVERY TIME the automotive industry uses a ton of sheet steel, 35 per cent of it becomes scrap. What a saving if some of it could be easily joined into bigger pieces from which parts could be blanked or drawn, just like from virgin metal!

If you've been following the industrial news, you know this is no pipe dream. A machine to make useful pieces out of scrap has been perfected and is about to be installed in one of the country's largest automobile plants. That company predicts a saving of $70,000 a year on one automobile stamping alone:

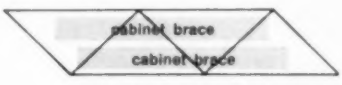
The machine is the Precision Butt-Seam Welder, a standard machine that



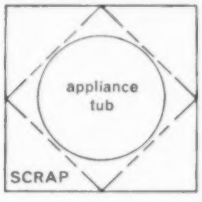
is easily adaptable to a great variety of scrap reduction programs. It butt welds sheet steel–mild, low alloy, high carbon or stainless–by the Peco butt-seam welding process.

The Precision Butt-Seam Welder can join pieces of metal edge to edge as fast as 24 feet per minute. The butt weld is made between foil strips of parent metal which increase resistance and contain the weld, so that it turns out scarcely thicker than the original sheet (approximately 10 per cent). You can deep draw a welded piece without cleanup, or dress the weld with a light grind for a smooth one-piece look.

Companies which generate a lot of flat scrap–automobile plants, appliance makers, large stamping shops–will find this unique welder especially useful. The sketch above gives just a hint of how an appliance maker might use metal he formerly had to scrap. You can find a dozen similar examples around almost any stamping shop, all of them representing dollars going to waste.



RECLAIMED STOCK PATTERN



Suppose you wanted to stamp out a part that looked like Oklahoma. No matter how you arranged it on the strip, you'd have lots of scrap. But suppose you blanked out the bulk of the state from one strip and the panhandle from another, and then butt-seam welded the two parts together. You'd cut your scrap in half–maybe more, your welded parts would be absolutely as good as those made of one piece, and your original metal costs would be far less!

For companies who want to stamp Oklahomas (or anything else) and save, we will be glad to supply any number of Precision Butt-Seam Welders. Also advice, know-how, service, and Precision Flexopresses to do the stamping.

Stock Jams Ended

A SIMPLE DEVICE, no bigger than a couple of decks of playing cards, is protecting presses these days from the dangers of overload. If an extra thickness of stock enters the die, this device stops the press.

So do lots of other safety stops, but this one is different. It isn't affected by current variations, or vibration, because it doesn't operate by those principles.

Called the Precision Flexostop, this device is mounted on the press next to the flywheel. Extra deflection of the flywheel, caused by overload, will trip the Flexostop, which can be adjusted to detect any variation in stock thickness greater than 0.010 in.

By an odd coincidence Precision Welder and Flexopress* salesmen just happen to carry a Flexostop or two in their briefcases. You might ask to see one. It can be installed on most any press with an air clutch in a matter of minutes.

**Flexopress–Its patented ball-bearing ram makes all others obsolete.*

Possibly you missed . . .

These objective articles about other Precision developments:

- ☐ Stock Fed Into Lamination Press at 2500 Inches a Minute, *Machinery*, February, 1958
- ☐ Magnetic-Force Method Welds Vinyl-Laminate Steel Sheet, *Product Engineering*, June 30, 1958

or want more information about these:

- ☐ Peco Butt-Seam Welding Process
- ☐ Precision Flexostop
- ☐ Precision Spot & Projection welders
- ☐ Precision Flexopresses with the Patented Ball-Bearing Ram

Check off what you want and let us know. We'll oblige.

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If the shape of your part is tubular, conical, hemispherical, or curvilinear, hydrospinning by the Ingersoll Kalamazoo Division may save you costly machining expense and time. If you want a seamless part, try hydrospinning. If you want precise wall thickness, turn to hydrospinning. Hydrospinning saves on metal, time and labor.

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Ingersoll Kalamazoo Division has an experienced engineering staff, and complete hydrospinning equipment. If you have a metal forming problem where hydrospinning may be of help to you, send an outline of your problem or contact the Defense Sales Dept. of

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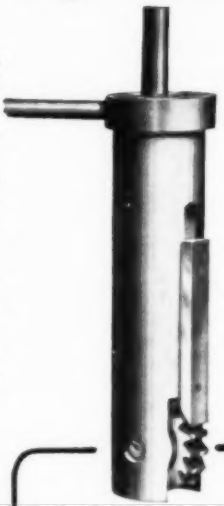
INGERSOLL KALAMAZOO DIVISION
1810 N. Pitcher St. • Kalamazoo, Michigan

The INSIDE STORY about NATIONAL Keyseating Millers

NATIONAL Keyseating Millers are designed for milling internal keyseats . . . in one cut . . . in offset holes . . . with parallel sides . . . partly through holes . . . of standard width and depth . . . in holes that are closed at one end . . . and many other operations. A demountable guide on body of Miller enters keyseat being milled assuring straight keyseat in perfect alignment with the axis of the bore, thus making it unnecessary to clamp work to drill press table.

CUTTERS are made from high speed steel which are hardened to Rockwell specifications and accurately ground to size. Tops of teeth are staggered to break chips which reduces strain and wear on both cutter and driving pins. It will pay you to put National Keyseating Millers on the inside of your next keyseating job.



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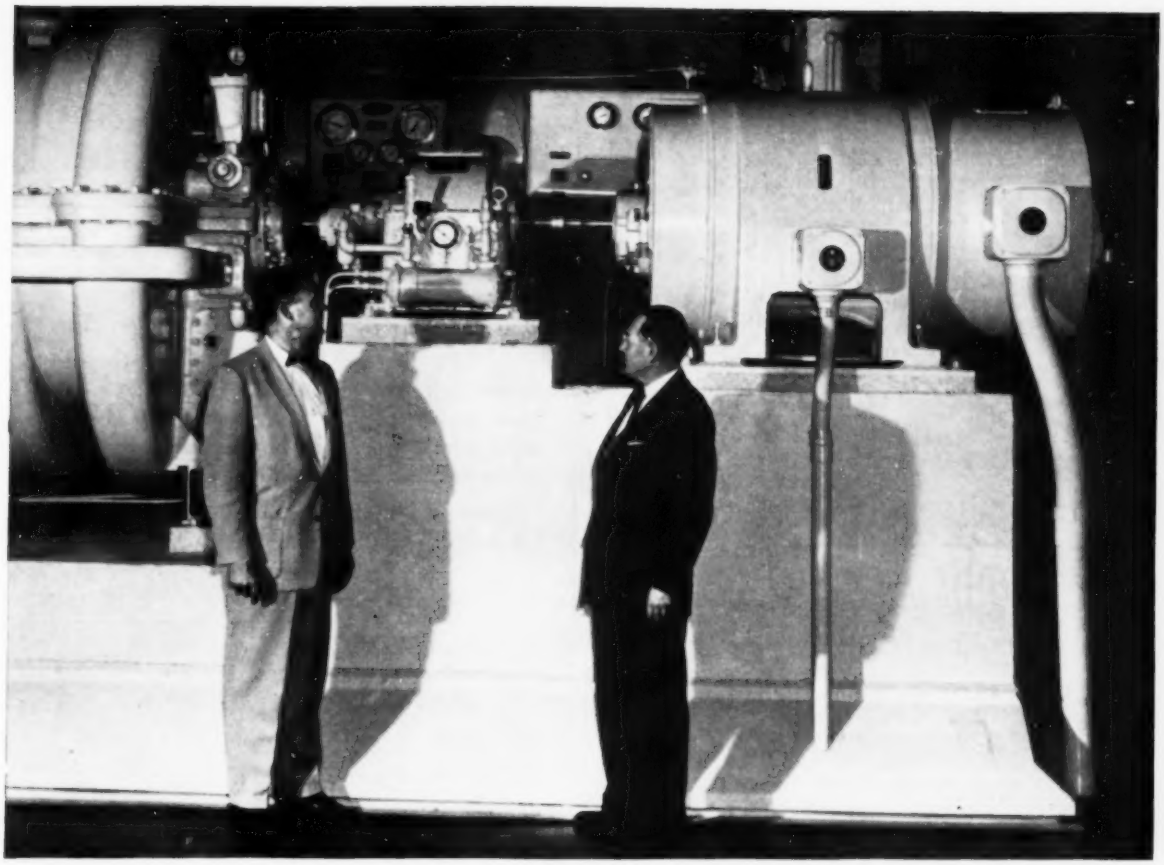

One of two Fairbanks-Morse 4160 volt, 700 hp. slip ring motors which power Carrier refrigeration compressors.

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Flexible control of new air conditioning system saves power and maintenance for Union Oil Center

Through a new Carrier dual-duct high-velocity system powered by Fairbanks-Morse slip ring motors, the magnificent new Union Oil Center in Los Angeles is ideally air-conditioned at minimum power and maintenance cost.

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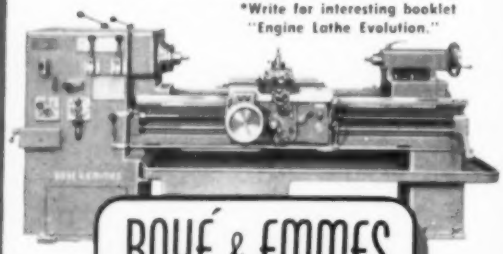

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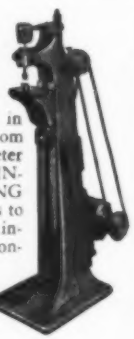

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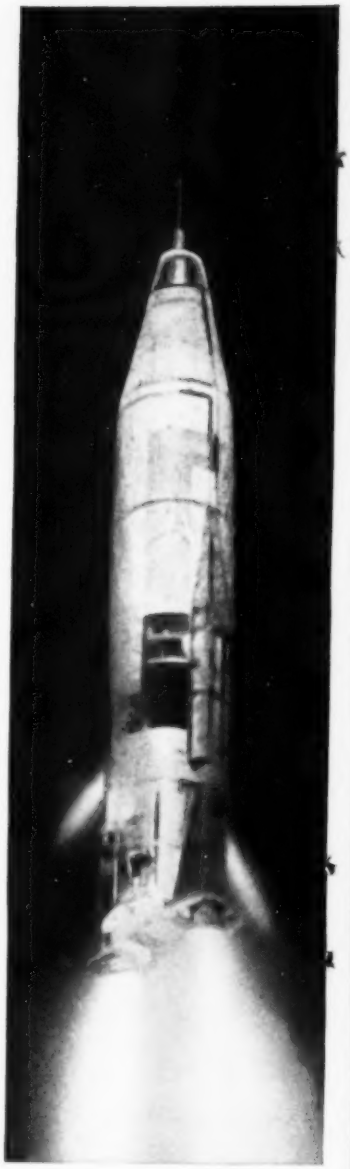


There is no opportunity for repairs once a "bird" is launched or is airborne.

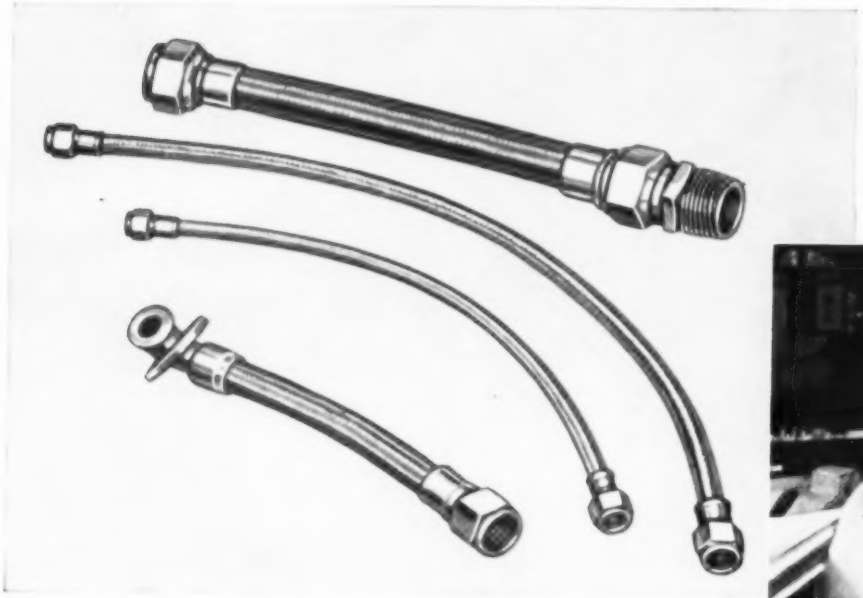
This fact is of prime consideration in a new high pressure hose assembly designed, developed, and manufactured by Resistoflex Corporation, Roseland, New Jersey. The hose is used for handling highly corrosive fluids in jet aircraft, missiles, and rockets.

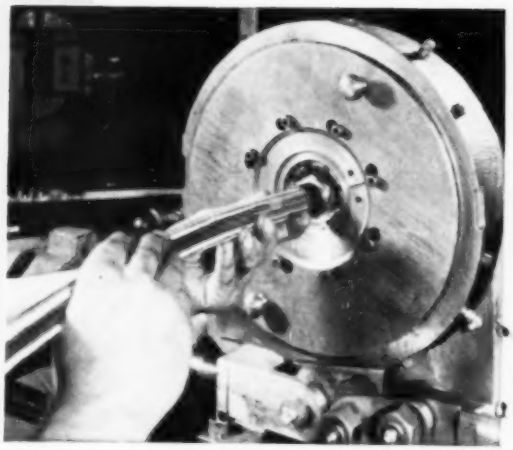
Utilizing a new type plastic sheathed in stainless steel wire braid, the hose features stainless steel fittings. Sockets, nipples, flanges, elbows, and swivel nuts are machined from ⅛-inch and 2-inch diameter stainless steel bars, of which Republic is a supplier. Fittings are permanently attached to the hose by swaging.

Republic Cold Finished Stainless Bar quality meets Resistoflex's high purchasing, inspection, and testing standards. Additionally, the bars meet the company's requirements for machinability, superior strength, and maximum corrosion-resistance.

If you machine stainless steel parts, you will like working with Republic ENDURO® Cold Finished Stainless Steel Bars. Here is a material with extremely high physical strength and excellent chemical properties. To these features have been added the advantages provided by the cold finishing process—close tolerance, accuracy of section, uniform soundness, fine surface finish.

Republic also supplies ENDURO in hot rolled bars, special bar sections, and wire. Machining specialists are available without obligation to assist you in obtaining the best possible results when machining Republic Stainless Steel Bars. The coupon is your invitation to use this service.

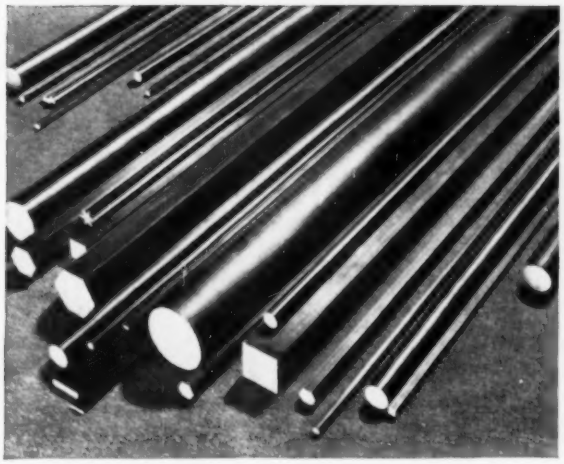




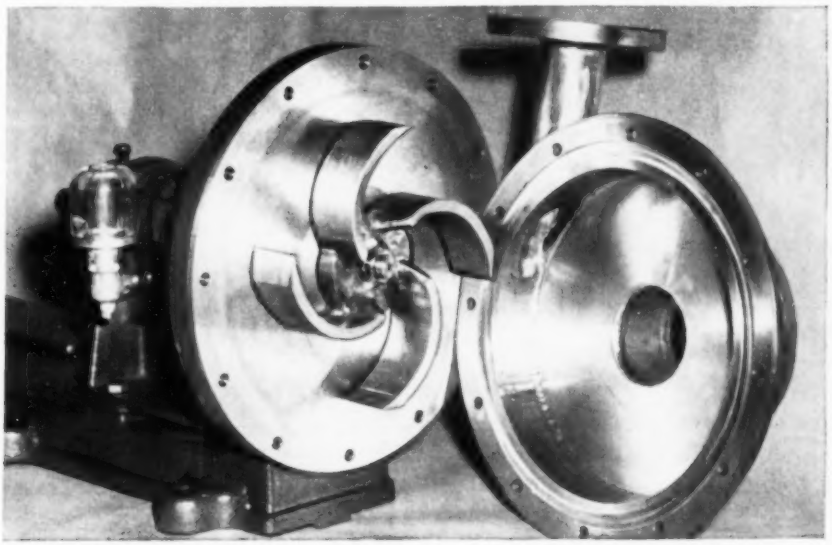
Resistoflex high pressure hose is sheathed in stainless steel wire braid. Various type fittings are machined from Republic Stainless Steel Bars.

Machined stainless steel fitting is permanently attached to hose in this crimping operation. Fittings are formed on automatic screw machines.

COLD DRAWN SPECIAL BAR SECTIONS lower costs, improve quality, increase production. Formed to the predominating cross-section of the part. Republic Special Bar Sections eliminate or greatly reduce required machining. Results are faster output and lower cost. Also, since cold drawing improves the mechanical properties of any given analysis, completed parts are stronger and longer wearing. Other advantages may include simplified design and improved appearance. Send coupon for complete facts.



HOT ROLLED BAR PRODUCTS from industry's most complete range of sizes and materials — carbon, alloy, stainless, and titanium — in 3/8" rd. to 10" rd. and equivalent footweight sections. Republic can meet your exacting requirements for high quality. Newly completed facilities are producing high quality alloy and carbon steel bar products in heavier coil weights, and more uniform sections.



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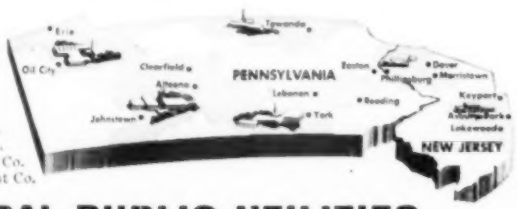

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2. Automatics
5. Bolt Machines
6. Boring Mills
7. Broaching Machines
10. Chucking Machines
11. Compressors
16. Drilling & Reaming Machines
24. Grinding Machines
29. Lathes
33. Milling Machines
40. Press Brakes
41. Presses
45. Riveting Equipment
48. Saws
49. Services
50. Shears
51. Shapers
58. Welding Equipment

ADVERTISER	PAGE NO.	KEY TO PRODUCTS OR SERVICES
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Cut All Tool Co.	270	48
The Eastern Machinery Co.	270	2, 5, 6, 7, 10, 11, 24, 41, 45, 58
Electric Equipment Co.	269	
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16" x 102" cc LeBlond Hv. Duty G. H. lathe, 12 spindle speeds 15 to 525, late type.

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No. 32 Lucas Table Type, m.d.
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10 ton, 84" stroke LaPoint Single Ram Vertical Surface Broach, m.d., late
Type SBD-42-6 American Vertical Hy. Dup. Broach
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38" Face Plate, Lathe, taper nose key mounted, new
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Clamping Assembly to fit a 6.2 Denver Acme Turret Lathe
1 ton Shaw Electric Cable Hoist
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Megatherm H.S. Induction Heating Unit
Model 75M, 75 ton Lempco Hand Operated Hydraulic Press, new
No. 74 Heald Workhead Assembly
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24"x24"x5" thick Diamond Cast Iron Lapping Plate
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Model 62A Grant Spinning Type Riveter
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Type 114-CB Moline Tool Boring Machine, 2 spindle type, m.d.

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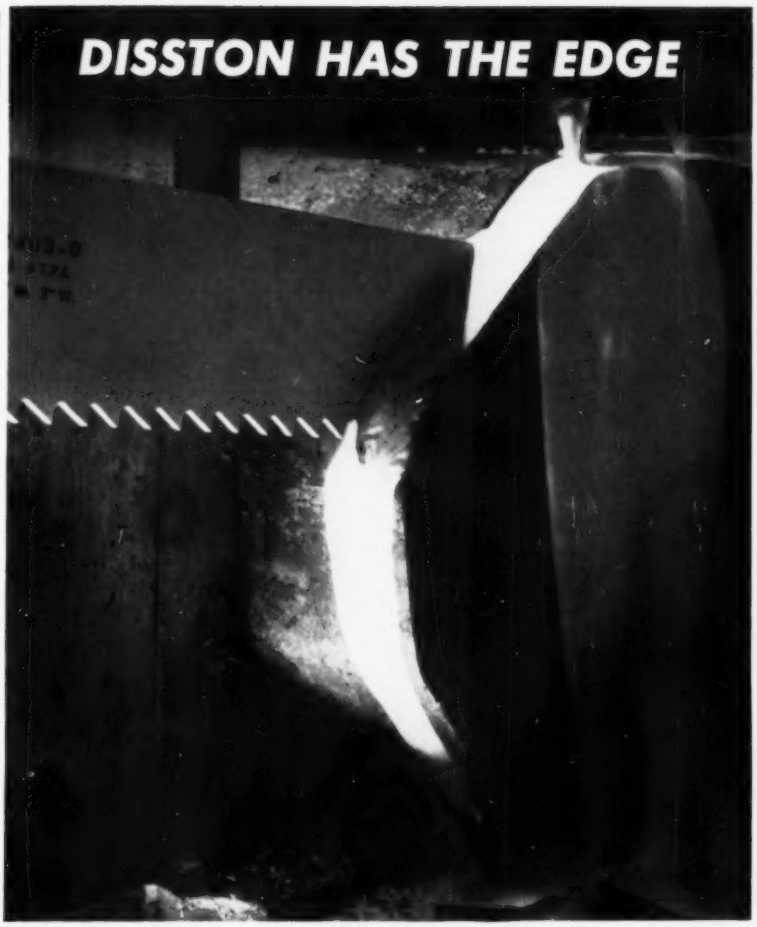

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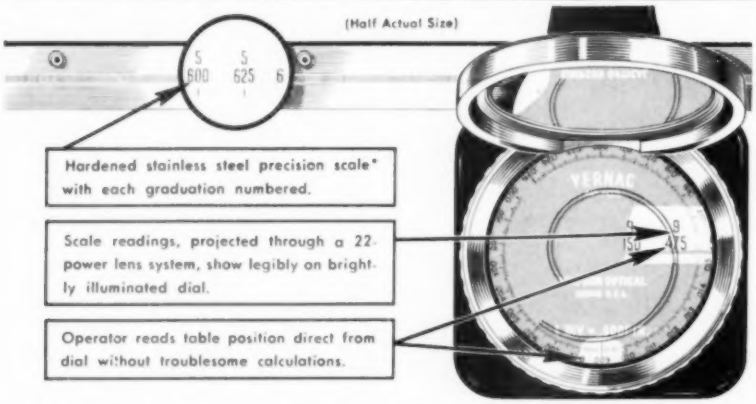
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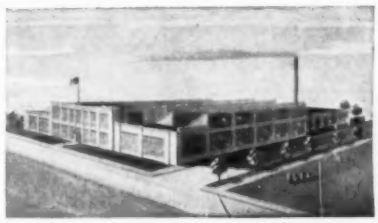

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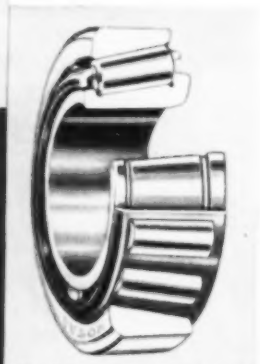
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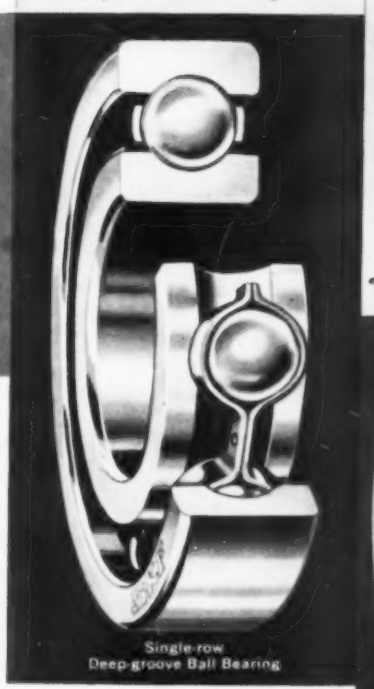
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3	25	47	69	91	113	135	157	179	201	223	245	267	289	311	333	355	377	399	421	443
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5	27	49	71	93	115	137	159	181	203	225	247	269	291	313	335	357	379	401	423	445
6	28	50	72	94	116	138	160	182	204	226	248	270	292	314	336	358	380	402	424	446
7	29	51	73	95	117	139	161	183	205	227	249	271	293	315	337	359	381	403	425	447
8	30	52	74	96	118	140	162	184	206	228	250	272	294	316	338	360	382	404	426	448
9	31	53	75	97	119	141	163	185	207	229	251	273	295	317	339	361	383	405	427	449
10	32	54	76	98	120	142	164	186	208	230	252	274	296	318	340	362	384	406	428	450
11	33	55	77	99	121	143	165	187	209	231	253	275	297	319	341	363	385	407	429	451
12	34	56	78	100	122	144	166	188	210	232	254	276	298	320	342	364	386	408	430	452
13	35	57	79	101	123	145	167	189	211	233	255	277	299	321	343	365	387	409	431	453
14	36	58	80	102	124	146	168	190	212	234	256	278	300	322	344	366	388	410	432	454
15	37	59	81	103	125	147	169	191	213	235	257	279	301	323	345	367	389	411	433	455
16	38	60	82	104	126	148	170	192	214	236	258	280	302	324	346	368	390	412	434	456
17	39	61	83	105	127	149	171	193	215	237	259	281	303	325	347	369	391	413	435	457
18	40	62	84	106	128	150	172	194	216	238	260	282	304	326	348	370	392	414	436	458
19	41	63	85	107	129	151	173	195	217	239	261	283	305	327	349	371	393	415	437	459
20	42	64	86	108	130	152	174	196	218	240	262	284	306	328	350	372	394	416	438	460
21	43	65	87	109	131	153	175	197	219	241	263	285	307	329	351	373	395	417	439	461
22	44	66	88	110	132	154	175	198	220	242	264	286	308	330	352	374	396	418	440	462

INSIDE FRONT COVER — INSIDE BACK COVER — BACK COVER

UNKEYED AD

Name

Title

Company Name

Address

City, State

SEARCHLIGHT SECTION

Samples	Used and Rebuilt Equipment		
500	507	514	521	528
501	508	515	522	529
502	509	516	523	530
503	510	517	524	531
504	511	518	525	532
505	512	519	526	533
506	513	520	527	534

(These are KEY numbers, not page numbers)

1	23	45	67	89	111	133	155	177	199	221	243	265	287	309	331	353	375	397	419	441
2	24	46	68	90	112	134	156	178	200	222	244	266	288	310	332	354	376	398	420	442
3	25	47	69	91	113	135	157	179	201	223	245	267	289	311	333	355	377	399	421	443
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9	31	53	75	97	119	141	163	185	207	229	251	273	295	317	339	361	383	405	427	449
10	32	54	76	98	120	142	164	186	208	230	252	274	296	318	340	362	384	406	428	450
11	33	55	77	99	121	143	165	187	209	231	253	275	297	319	341	363	385	407	429	451
12	34	56	78	100	122	144	166	188	210	232	254	276	298	320	342	364	386	408	430	452
13	35	57	79	101	123	145	167	189	211	233	255	277	299	321	343	365	387	409	431	453
14	36	58	80	102	124	146	168	190	212	234	256	278	300	322	344	366	388	410	432	454
15	37	59	81	103	125	147	169	191	213	235	257	279	301	323	345	367	389	411	433	455
16	38	60	82	104	126	148	170	192	214	236	258	280	302	324	346	368	390	412	434	456
17	39	61	83	105	127	149	171	193	215	237	259	281	303	325	347	369	391	413	435	457
18	40	62	84	106	128	150	172	194	216	238	260	282	304	326	348	370	392	414	436	458
19	41	63	85	107	129	151	173	195	217	239	261	283	305	327	349	371	393	415	437	459
20	42	64	86	108	130	152	174	196	218	240	262	284	306	328	350	372	394	416	438	460
21	43	65	87	109	131	153	175	197	219	241	263	285	307	329	351	373	395	417	439	461
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505	512	519	526	533
506	513	520	527	534

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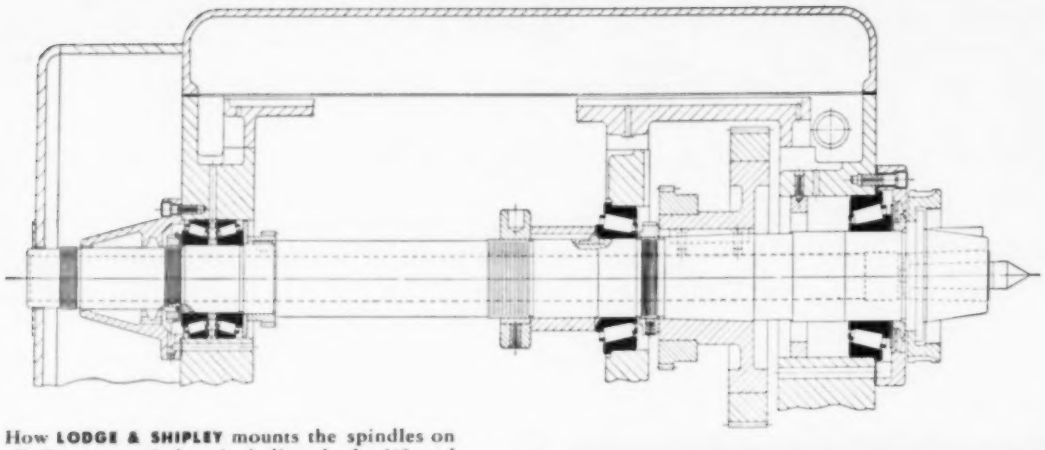

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How spindle is held rigid. Timken bearings hold the spindle in positive alignment. They take *both* radial and thrust loads in any combination, because of their tapered design. And because of full line contact between rollers and races, Timken bearings have extra load-carrying capacity.

Why heavy shocks are absorbed. Case-carburization of Timken bearings' rollers and races gives them hard, wear-resistant surfaces and tough, shock-resistant cores.

How friction is virtually eliminated. Timken bearings are geometrically designed to roll true. And they're precision-made to live up to their design. They run smoother—last longer.

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